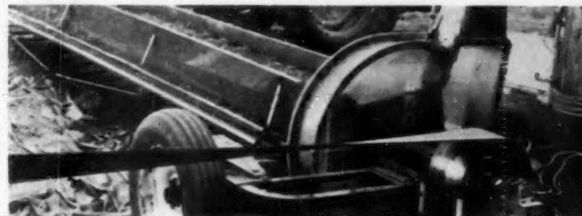
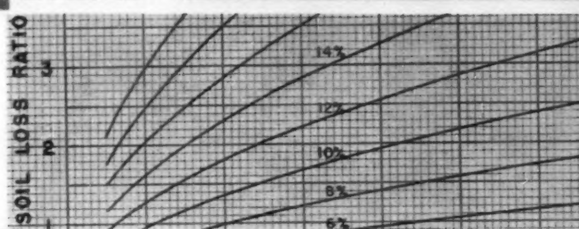
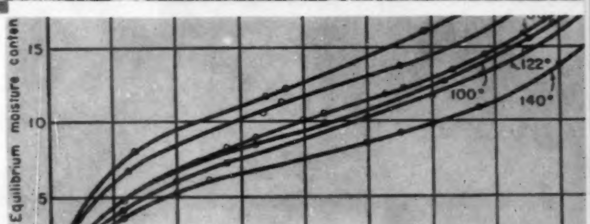
AUGUST 1958

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers







(For more facts circle No. 63 on reply card)

Agricultural Engineering

Established 1920

CONTENTS • AUGUST, 1958 • Vol. 39, No. 8

Note: AGRICULTURAL ENGINEERING is regularly indexed by Engineering Index and by Agricultural Index. Volumes of AGRICULTURAL ENGINEERING, in microfilm, are available (beginning with Vol. 32, 1951), and inquiries concerning purchase should be directed to University Microfilms, 313 North First Street, Ann Arbor, Michigan.

AGRICULTURAL ENGINEERING is owned and published monthly by the American Society of Agricultural Engineers. Editorial, subscription and advertising departments are at the central office of the Society, 420 Main St., St. Joseph, Mich. (Telephone: YUkon 3-2700).

JAMES BASSELMAN, *Editor and Publisher*

SUBSCRIPTION PRICE: $5.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to ASAE members anywhere, $3.00 a year. Single copies (current), 50 cents each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

The American Society of Agricultural Engineers is not responsible for statements and opinions advanced in its meetings or printed in its publications; they represent the views of the individuals to whom they are credited and are not binding on the society as a whole.

TITLE: The title AGRICULTURAL ENGINEERING is registered in the United States Patent Office.

AGRICULTURAL ENGINEERING is a member of the Audit Bureau of Circulations.

IN MEMORIAM

WALTER B. JONES, copy chief, Western Advertising Agency, Racine, Wis., and a member of the American Society of Agricultural Engineers for almost 40 years, died Friday, July 18. He had been in failing health since March.

Mr. Jones was born near Polo, Ill., on July 2, 1890, and attended Polo High School. Following graduation from Cornell College, Mt. Vernon, Iowa, where he received a bachelor of science degree, he taught science at East Greenwich Academy in Rhode Island. Later he was an instructor in farm mechanics at the University of Illinois until 1919, when he became one of the editors of *Power Farming*, a national publication devoted to mechanized agriculture, and *Power Farming Dealer*, a farm implement trade publication. Following the sale of *Power Farming* to a Detroit publisher in 1923, Mr. Jones continued as editor of *Power Farming Dealer* until 1927 when he accepted a position in the advertising department of Deere & Company as a copy writer. In 1929 he became associated with the copy staff of what is now the Reincke, Meyer & Finn advertising agency in Chicago.

WALTER B. JONES

He had been connected with the Western Advertising Agency in Racine, Wis., from 1935 until his retirement in March of this year. During the greater part of his 23 years' association with this agency, he was employed as copy chief.

Since the late 1920's Mr. Jones had done regular and special writing assignments for the American Society of Agricultural Engineers, principally advertising promotional material for the Society's publications. Especially noteworthy was a monthly promotion piece, called the "Bulletin," which featured the commercial significance of a particular article in each current issue of AGRICULTURAL ENGINEERING. The "Bulletin" circulated to advertising executives and received much favorable comment as a worthy example of advertising promotion.

Mr. Jones possessed unusual ability for colorful writing, and the excellent biographies he prepared each year of the ASAE medalists, from the inception of both the McCormick and Deere gold medals, received much praiseworthy comment.

Though not a graduate engineer, Mr. Jones practiced engineering and for years maintained his own consulting firm in St. Joseph. He is survived by his widow, also by three sons and two daughters. He was a member of the Episcopal Church, of the Mystic Tie Masonic Lodge, and of the Kiwanis Club.

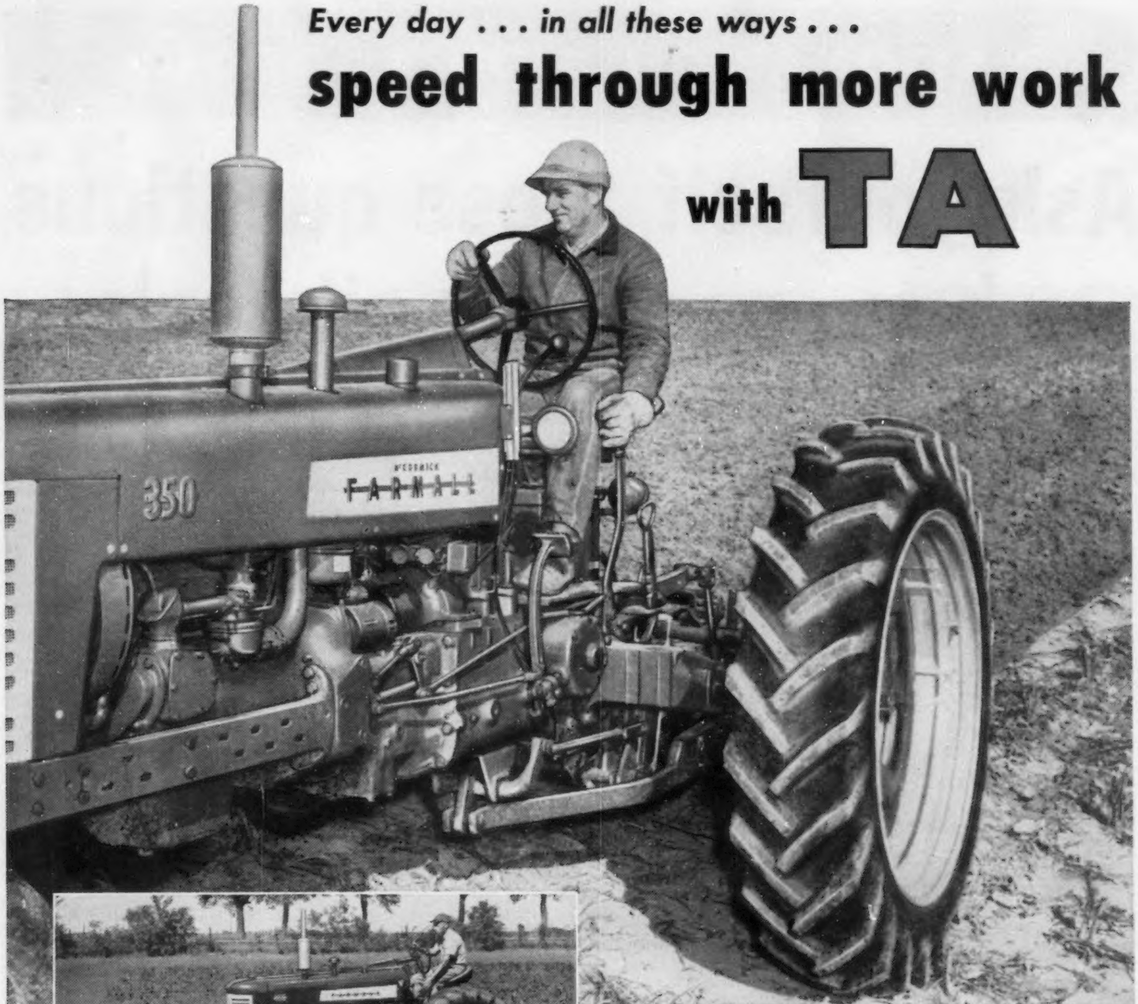
Special Issue in September

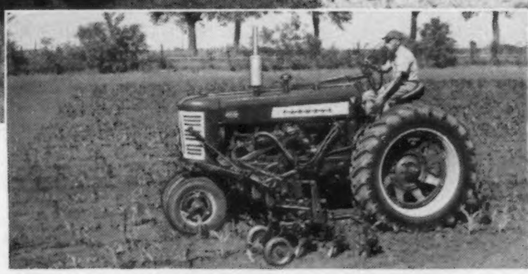
THE September issue of AGRICULTURAL ENGINEERING will be a special number devoted entirely to materials handling on the farm. Complete proceedings of the Farm Materials Handling Conference to be held at Iowa State College, Ames, September 17 to 19, as well as other materials handling information will be included. Extra copies and information on quantity prices may be obtained by writing ASAE, 420 Main St., St. Joseph, Mich. (See page 455)

(For more facts circle No. 58 on reply card)

Every day . . . in all these ways . . .

speed through more work with TA





You'll save minutes and movements on every turn when you cultivate with TA. Just pull the TA lever to slow down 30% for safer, full-power turns, then release the TA lever to resume top cultivating speed.

Pull TA lever to take bunchy windrows in stride. TA reduces forward travel instantly, yet keeps pto machines at full-rated rpm to handle sudden overloads. There's no clutch slippage, no loss of efficiency, no fuel waste.

Name any job—plowing, planting, cultivating, baling, hauling! You can do it faster, easier, at lower cost with *exclusive* IH Torque Amplifier drive on a new Farmall® or International® tractor.

TA is the big difference that puts IH tractors in a class by themselves! Ten speeds forward—two in each gear—match every job, hurry all work. TA gives you instant pull-power increase of up to 45% that keeps you going *non-stop* when others must shift.

From winter chores through fall harvest, Torque Amplifier drive puts IH tractor power to better use.

See why you're a BIGGER MAN on a new IH TRACTOR!

Your IH dealer will gladly demonstrate Torque-Amplifier, Traction-Control Fast-Hitch, Hydra-Touch hydraulics, and all other IH features.

SEE YOUR

INTERNATIONAL HARVESTER DEALER

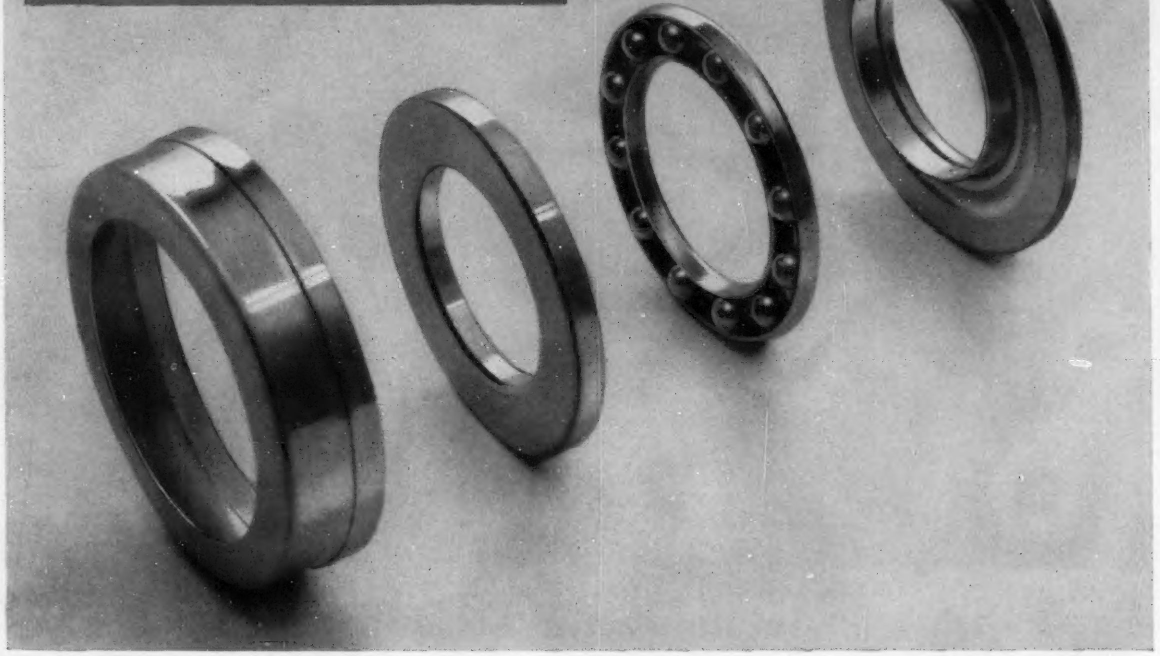
International Harvester Products *pay for themselves in use*—Farm Tractors and Equipment . . . Twine . . . Commercial Wheel Tractors . . . Motor Trucks . . . Construction Equipment—General Office, Chicago 1, Illinois.

(For more facts circle No. 71 on reply card)

(For more facts circle No. 60 on reply card)

Engineers Specify BCA
Precision Clutch Bearings . . . for

2 BASIC REASONS



Endurance...

BCA precision clutch bearings exceed engineers' most severe test standards . . . over 70,000 declutchings at speeds corresponding to more than 60 mph. Performance like that results from such BCA construction features as . . . high carbon chrome balls . . . carburized and precision ground steel washers . . . single piece U-section retainer, designed to trap grease between the rotating members . . . labyrinth sealed with rigged pressed steel housing and special bronze ferrule . . . packed with a stable, high temperature grease.

Economy...

BCA precision clutch bearings offer real dollar savings because of . . .

- **low initial cost**
- **easy installation**
- **trouble free service.**

BCA precision clutch release bearings are backed by 60 years of ball bearing design and manufacturing experience—for all kinds of vehicle applications. Specify BCA clutch bearings for real endurance and economy. Bearings Company of America Division, Federal-Mogul-Bower Bearings, Inc., Lancaster, Pa.

Call BCA Engineers on matters pertaining to bearing problems.

BCA

BEARINGS COMPANY OF AMERICA
DIVISION OF
Federal-Mogul-Bower Bearings, Inc.

BOWER · FEDERAL Mogul · BCA · NATIONAL SEALS

(For more facts circle No. 69 on reply card)

Report to Readers . . .

MACHINE TAKES HIGH LABOR COST OUT OF HARVESTING PRUNE CROP

Usual harvesting practice is to pick prunes off the ground, not from the trees. As they ripen and fall to the ground, either with or without shaking the trees, they are picked up by hand—400,000 tons of them annually in four western states. Because of the vast amount of stoop labor this harvesting job involves, research agricultural engineers of the USDA and the California AES in their search for a solution have developed an experimental mechanical harvester. It is a one-man, self-propelled machine that picks up a 20-inch swath of prunes from the ground at the rate of around 1,000 pounds an hour, replacing about four hand laborers. A public patent on the principle used is being applied for, and the engineers will seek to interest manufacturers in producing it. . . . . The pickup device on the experimental machine resembles a washing-machine wringer. Two small, heavily padded sponge-rubber rollers rotate in opposite directions, and as the machine moves over the ground, the fallen prunes are pulled into the space between the rollers and tossed back onto a conveyor belt that carries the fruit to a box at the rear of the machine. It is essential that the orchard floor be level and free of stones, broken branches, etc, to insure most efficient operation of this harvester. At least two runs through the orchard are necessary to pick up all the prunes where not all the fruit on a tree matures at the same time. . . . . The engineers are experimenting with mechanical tree shakers for removing all the fruit in cases where the entire crop on a tree ripens at about the same time.

RESEARCH RESULTS PROVE MOTOR OILS DO WEAR OUT

For a long time there has persisted the belief that motor oils do not actually wear out, and that they can be satisfactorily reclaimed and reused. This idea, however, was recently challenged by the research director of one of the leading oil companies. He stated before an API lubrication committee that once a motor oil has been used in a modern high-speed engine, it cannot be restored to its original form. Even with available drastic filtration processes, it is not possible to produce an oil that is just as good after use as it was before. The reason is that it is not merely a problem of removing impurities. That use of an oil materially affects its viscosity, color, and additive content is proven conclusively by filtration tests. Even if used oils are subjected to a reclaiming process, they must also be refortified with additives before they are ready for reuse.

DOUBLE USE OF IRRIGATION WATER PRESENTS ENGINEERING PROBLEMS

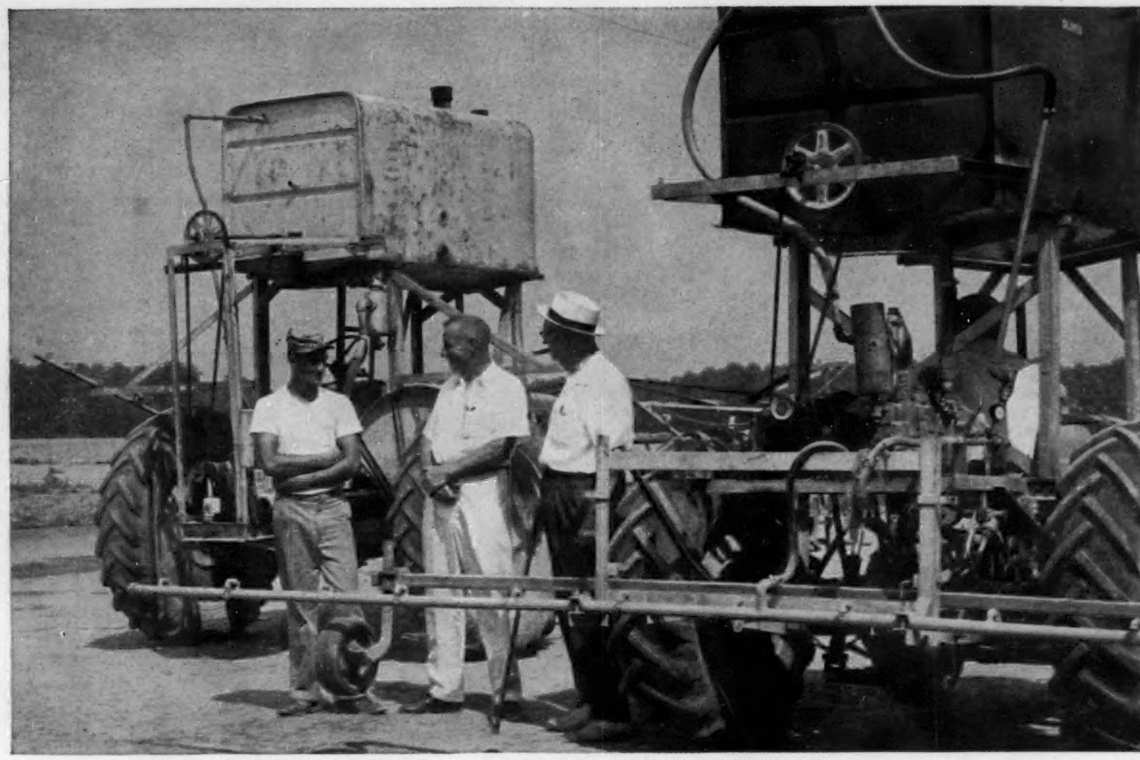
Not all irrigation water when applied soaks into the thirsty soil. That which is not taken up by the soil, called "tail water," runs off at the lower ends of most fields. This represents a substantial loss, and may amount to as much as 20 to 25 percent of the water applied. Farm and ranch users of water from the large storage reservoirs naturally deplore any loss of valuable water and have sought ways and means to avert it. . . . . The Soil Conservation Service (USDA) reports one California farmer as having achieved some success in this direction. With SCS engineering help, this man devised a "pump-back" or return water system by building concrete-lined sumps at the lower ends of his fields. Tail water draining into these sumps is raised by deep-well centrifugal pumps to a concrete pipeline, from which it is carried into

irrigation lines for reuse. . . . . Irrigators who reuse irrigation runoff through sump returns, like the "second-hand" water because it is warmer and richer, containing plenty of leached fertilizer and manure. Besides it is a great help, especially when water is in short supply and hard to get. . . . . Usually water users will be well-advised if they are encouraged not to undertake the planning, construction, and equipping of "pump-back" systems without competent engineering assistance. Otherwise such systems can be highly expensive or of doubtful value, or both.

PROGRESS IN CONTROLLING SUMMER ENVIRONMENT OF FARM LIVESTOCK A notable engineering achievement of recent years, typical of the field of engineering served by this publication, is the work of research agricultural engineers in developing improved control of the summer environment of farm animals, so essential to their ability to produce. The five main control factors involved have been summed up concisely by S. S. DeForest, following consultation with four leading agricultural-engineering research specialists in this field, as follows: (1) Create a low radiant heat load. Good sunshades are most economical for cooling livestock, and they need to be kept as high as possible (at least 12 feet) and be portable. Aluminum or galvanized steel sheets painted white on top are best. (2) Keep drinking water cool. This means as near ground temperature as possible. (3) Create artificial sweat. Foggers or sprays are best suited for cattle and laying hens, and wallows for hogs. (4) Provide artificial breeze. Large fans increase air movement, especially in buildings. Wire rather than board fences lower temperatures in feedlots or corrals. (5) Create cool environment. Evaporative coolers are practical where humidity is low. Though the investment would be high, the ultimate in creating a controlled, cool environment is mechanical refrigeration or heat pumps.

COMBINATION HAY-CORN CROP AIDS SOIL EROSION CONTROL A way to combine a hay crop with corn for more effective soil erosion control is reported to have been developed by University of Wisconsin soil conservation researchers. They planted 20-inch bands of hay between 60-inch corn rows. This not only cut water loss but practically eliminated soil loss on sloping land. However, the grass band has to be kept clipped to shorter than 6 inches so as not to reduce corn yields drastically. . . . . In the case of clipped or dead-hay strips, average yield was 82 bushels per acre and the soil loss 100 pounds. Losses from an unclipped band were about 20 pounds, but the yield was reduced to an average of 73 bushels per acre. Since clipped bands will support higher yields than in the case of unclipped bands, without much more soil and water loss, clipping the bands appears to be the best practice.

BELT-TUBE ELEVATOR HANDLES BOTH SILAGE AND CHOPPED HAY Using a 10-inch, inside-diameter tube and a rubber belt instead of chains and flights, a Cornell University agricultural engineer has developed a new tube elevator that is described as faster, shorter, easier. It will move chopped hay or grass silage at 1,000 feet per minute, or three times faster than conventional elevators. It is shorter and easier to handle since it can be used almost vertically (85 degrees). . . . . In use, chopped hay or silage is dropped at a uniform rate from the wagon on to the feed table, and then dragged to the carrier belt by a fingered chain. The belt is flat on the feed table but conforms to the inside of the elevator tube. A 5 to 7½-horsepower electric motor is required for operation.



FARM-MADE SPRAYERS HAVE UNIQUE ADVANTAGES

These sprayers, mounted in tractors, were designed by John Van Kesteren, Jr., who conducts an 800-acre truck farm operation near Onancock, Va.

Each self-contained unit tracks where it is driven, preventing damage to plants at row ends. Tractors are used for other work without dismantling the sprayers, saving time and money. And the chain-driven pump eliminates the use of a universal. Also, the 500-gallon overhead tank provides sun-shade for the driver!

Shown left to right are Mr. Van Kesteren's son, John, Mr. Van Kesteren and Texaco Distributor H. C. Watson. For 20 years the latter has supplied Texaco products to owner Van Kesteren, who agrees with farmers everywhere that *it pays to farm with Texaco.*

THEY LIKE MARFAK! Texaco Marfak lubricant is best for farm machinery because it won't drip out, wash out, dry out or cake up. In agreement are farmers J. C. Blalock (standing), J. D. Lowman (on tractor), Dodge Dealer Mack Carter (lower left) and Texaco Consignee R. E. Stafford, all of the Mershan-Waycross, Ga., area.

GEORGE SCHOEDER (on tractor) of the Krier Preserving Co., Belgium, Wis., gets a delivery of Havoline Motor Oil from Texaco Distributor Jack Wilson. 17 vegetables are canned by Krier. Havoline is the preferred motor oil here for tractors and trucks because it wear-proofs engines, prolongs their life.

IN ALL 48 STATES—You'll find Texaco Dealers with top-octane Texaco Sky Chief Su-preme gasoline supercharged with Petrox for instant power, and famous Fire Chief gasoline at regular price. Also Havoline Motor Oil and Marfak lubricant. These top-quality Texaco products have won acceptance with motorists everywhere.

On farm and highway it pays to use

TEXACO PRODUCTS

Texaco Products are also distributed in Canada, Latin America, and Africa.

THE TEXAS COMPANY

(For more facts circle No. 61 on reply card)

Only the finest, toughest, longest-wearing steel is good enough for Ingersoll discs and coulter blades. That's why—*more than 20 years ago*—Ingersoll developed TEM-CROSS steel.

This super-tough steel is cross rolled at right angles to the initial rolling to eliminate single direction grain which might cause failure under impact. The interlocking mesh-grain structure of TEM-CROSS steel takes the shock and strain of hard field use, and assures maximum resistance to splitting. This has been proved in test after test at the United States Department of Agriculture Tillage Machinery Laboratory, which showed that discs made of cross rolled steel are far more resistant to impact and fatigue than discs made of straight rolled steel. And that means longer life—more acres of useful service.

Only Ingersoll discs and coulter blades are made of TEM-CROSS steel. And that's one of the big reasons why every leading implement maker uses Ingersoll blades on his tillage tools.

To be sure your customers get this original equipment quality when they need replacements, order Ingersoll discs direct from the maker of the implements you sell.

Forcing a 1" ball through a ½" hole drilled in a cross rolled disc makes only small, random cracks.

Nicked in the field, this cross rolled steel disc didn't split, is still usable.

This straight rolled disc split and broke under field impact.

Ingersoll *Heat-Treated* Discs

INGERSOLL PRODUCTS B-W BORG-WARNER

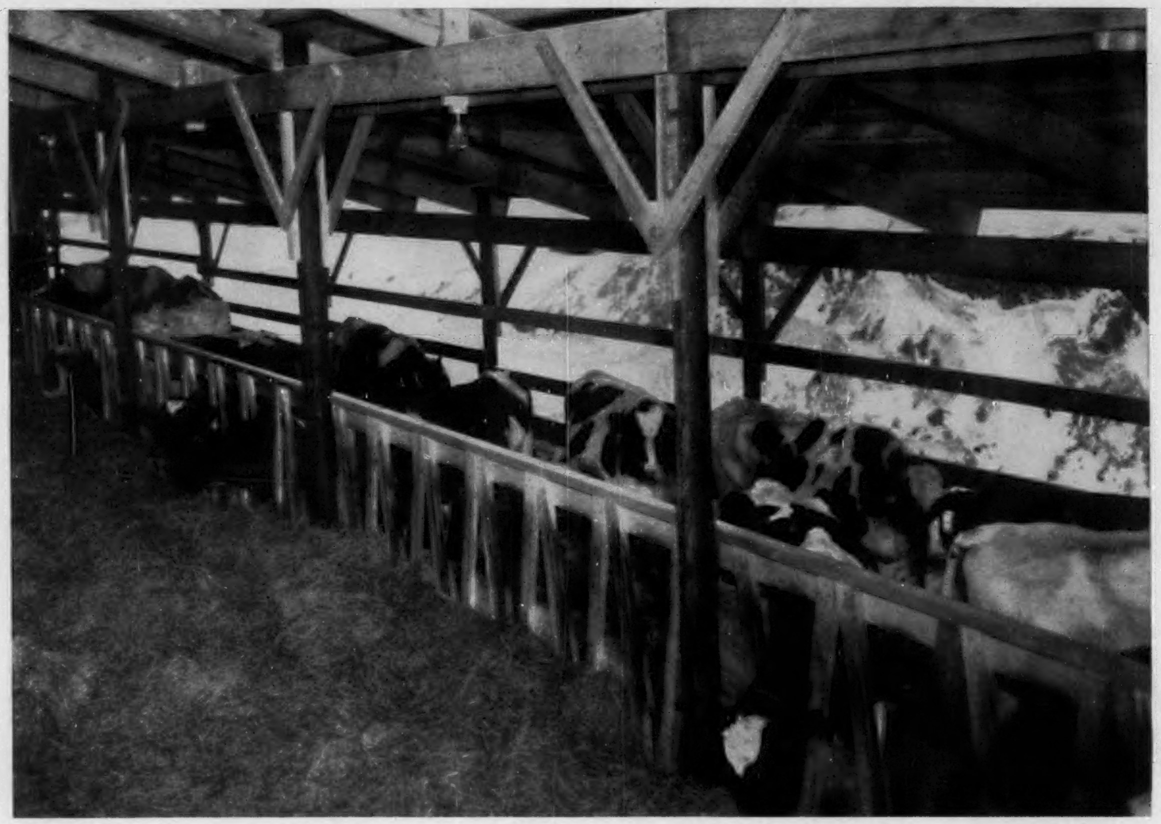
Ingersoll PRODUCTS DIVISION

BORG-WARNER CORPORATION • Chicago 43, Illinois

SPECIALISTS IN TILLAGE STEELS • WORLD'S LARGEST MANUFACTURER OF DISCS

THE ONLY MANUFACTURER OF DURA-DISC — THE STEEL THAT IS THE ECONOMICAL REPLACEMENT FOR HIGH-COST ALLOYS

Pressure-creosoted poles and lumber last up to 50 years and require no maintenance.



Pole-type construction saves money! Loose housing saves time!

This modern barn was built with low-cost pole-type construction . . . and the planned arrangement of its hay racks and self-feeding box silo will save *work* and *time*. Only a few minutes each week are required to fill the self-feeding hay racks. Silage feeding is automatic as the cows help themselves, free choice. Little labor necessary—no time lost.

With pressure-creosoted pole construction, the original building cost is kept low. There is no foundation to pour, no mortises to cut, and framing is simple. The USS Galvanized Roofing and Siding goes on in a hurry and produces a strong, fire-resistant building that stays tight in any weather.

To prevent damage from termites, rot and decay, pressure-creosoted lumber is used. All pressure-creosoted wood should contain 6 to 8 pounds of creosote per cubic foot to assure long service life.

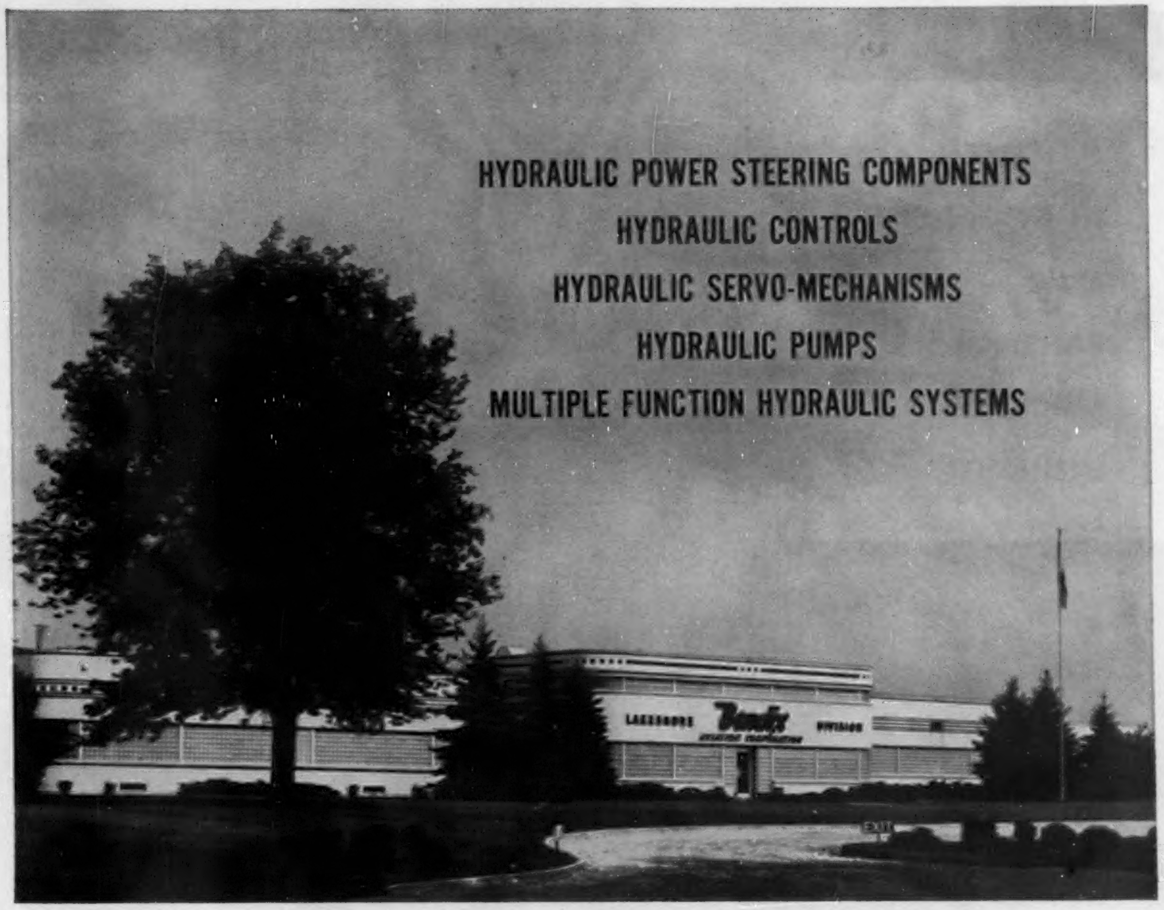
See your local farm supply dealer for pressure-creosoted poles, or write direct to United States Steel, Room 2831, 525 William Penn Place, Pittsburgh 30, Pa.

Note: U. S. Steel does not sell pressure-creosoted wood, but supplies creosote to the wood-treating industry.

USS is a registered trademark

Sales Offices in Pittsburgh, New York, Chicago, Salt Lake City and Fairfield, Alabama

USS Creosote



IT'S BENDIX-LAKESHORE FOR COMPLETE HYDRAULIC ENGINEERING AND MANUFACTURING

—Automotive or Agricultural—

Whatever your needs in agricultural or automotive hydraulic components, you'll be wise to look first to Bendix-Lakeshore. One of the newest and most modern divisions of the great Bendix Aviation Corporation, Bendix-Lakeshore is geared to provide you with fast, efficient service on any product, whether it's designed by our own skilled engineering staff or produced here from your design.

Despite being a comparatively new division, Lakeshore is old in experience. Backed by the great resources of Bendix Aviation Corporation, it is staffed in large part by engineers who have spent an aggregate of hundreds of years in hydraulic research and design, both with Bendix* and other firms. Solid engineering research and extensive testing are standard procedure with us. When you order hydraulic components from Bendix-Lakeshore, you get the benefit of complete engineering facilities.

Bendix-Lakeshore's reputation for quality in the field of hydraulic components has helped us acquire, in the space of five years, a list of customers whose standards are beyond question. Remember, if you have a problem in engineering or manufacturing of automotive or agricultural hydraulic components, it will pay you to investigate the facilities and abilities of Bendix-Lakeshore in these specialized fields.

*TRADEMARK

Lakeshore Division
St. Joseph, Michigan

Bendix
AVIATION CORPORATION

(For more facts circle No. 59 on reply card)

PARTNER
IN PROGRESS
to the
FARM
MACHINERY
INDUSTRY

MINNEAPOLIS-MOLINE—one of the leading engine manufacturers using Perfect Circle chrome rings for both original equipment and service requirements.

When you look into the reasons why the name "Perfect Circle" has become a world-wide synonym for excellence in piston rings, three basic factors emerge: research facilities, engineering leadership, and manufacturing skills unmatched in the industry.

Whenever you have a problem concerning piston rings or their application, you are invited to consult with our research and engineering "team." Perfect Circle Corporation, Hagerstown, Indiana; The Perfect Circle Co., Ltd., Don Mills, Ontario, Canada.

PERFECT CIRCLE PISTON RINGS

Agricultural Engineering

August, 1958
Number 8
Volume 39

James Basselman, *Editor*

Materials Handling Conference

THE first national materials handling conference devoted specifically to agricultural materials will be held September 17 and 18 at Iowa State College, Ames. The conference, sponsored by the American Society of Agricultural Engineers, will be held in conjunction with the annual Iowa Agricultural Engineering Field Day, September 19, which is sponsored by the agricultural engineering department of Iowa State College.

The objectives of the conference are to stimulate and encourage basic, systematic progress among colleges, industries, power companies, and others in the development of materials handling methods for farms; to provide a reference for agricultural engineers, manufacturers, dealers, and farmers on the subject; and to establish the American Society of Agricultural Engineers and the agricultural engineering profession as the authoritative source for agricultural materials handling information.

Careful planning by the Committee for the Conference on Materials Handling, with S. S. DeForest, engineering editor, *Successful Farming,* as chairman, has resulted in an outstanding program. The program subcommittee, headed by W. M. Carleton has lined up top-notch speakers and the subcommittee on local arrangements, headed by N. H. Curry, has made arrangements for crops to be grown at the site for actual crop-handling demonstrations.

The sessions are planned to be of interest to agricultural engineers, power suppliers, farmers and manufacturers and dealers in buildings and equipment for storing, processing and handling agricultural materials. Speakers will discuss all materials farmers handle including hay, silage, grain, ground feed, water, manure, products farmers buy, and products farmers sell.

The conference will bring together for the first time pertinent information that will further accelerate the trend toward mechanizing the farmstead and reducing the cost and hard labor presently associated with many farm materials handling chores — a need recognized by the Council of ASAE when it asked for the formation of a committee to explore the possibilities of such a conference.

The September issue of AGRICULTURAL ENGINEERING will carry all the papers presented during this conference, as well as other materials handling features. By reason of the scope of the material it will contain, this special issue promises to be a comprehensive handbook on farm materials handling. Following is a preview of the program.

The Wednesday morning session will open with an introduction to handling materials on farms by G. H. Seferovich, Editor, *Implement and Tractor,* in which he will review its significance, status and outlook. C. W. Hall, Michigan State University, will follow with a discussion of the theoretical considerations in materials-handling systems. On Wednesday afternoon the theme will be principles of farm materials-handling. W. W. Gunkel, Cornell University; H. J. Barre, Mansfield, Ohio, and M. E. Singley, Rutgers University, will discuss liquid materials, bulk granular materials, and non-free-flowing materials, respectively. The evening program will include a presentation of lantern slides and motion pictures to illustrate techniques of handling agricultural products.

The theme for Thursday morning will be application of basic handling principles to representative products. Papers on liquid materials will be presented by J. F. Schrunk, Irrigation Equipment Co., who will give the discussion on water; W. E. Shiffermiller, the Borden Co., who will speak on milk, and C. M. Hansen, Michigan State University, who will discuss liquid fertilizer, liquid manure, liquid feeds, sprays, fungicides, herbicides, etc. A paper on free-flowing materials will be given by W. F. Millier. The discussion on non-free-flowing materials will be given by E. C. Schneider, University of Vermont who will speak on hay and manure; J. H. Ebbinghaus, A. O. Smith Corp., on silage; and H. B. Puckett, Farm Electrification Research Laboratory, USDA, who will discuss removing and metering non-free-flowing materials from bulk storage. J. H. Levin (AERD, ARS) USDA, will give a paper on unit handling of fruits and vegetables; C. L. Martin, The Farmhand Co., will present a discussion on loads, stacks, etc., and M. L. Todd of Todd, Hedeen & Associates, will discuss engineering analysis of an actual materials-handling installation in a paper entitled "From Field to Mill." These three papers will be relative to the subject of unit (batch) materials. The evening session will consist of an analysis of what the mechanization of farm materials-handling portends for farming as a business, to be given by Kirk Fox, editor emeritus, *Successful Farming,* in a paper "The Job Ahead for Farm Materials-Handling."

On Friday there will be exhibits and field demonstrations of typical farm materials-handling equipment and systems as part of the annual Iowa Agricultural Engineering Field Day sponsored by the agricultural engineering department of Iowa State College. Displays, exhibits and demonstrations will be set up so that agricultural materials handling can be demonstrated from "field to storage, through processing, to livestock, to market." Information regarding reservations and registration may be obtained by writing to N. H. Curry, Agricultural Engineering Dept., Iowa State College, Ames. Copies of the program and quantity prices of the September issue may be obtained by writing to ASAE, 420 Main St., St. Joseph, Mich.

Farm Materials Handling Conference • Iowa State College • September 17-19, 1958

Effect of Paddle Tip-Clearance on Forage Blower Performance

H. E. McLeod
Assoc. Member ASAE

K. K. Barnes
Member ASAE

Engineering tests show need for a relatively large paddle tip-clearance, also for a fundamental approach to housing, impeller, and paddle configuration and to placement of incoming material

DESIGNERS of forage blowers have generally fixed the clearance between the outer end of the paddles and the blower housing as small as could be maintained in production with the type of construction used. This practice has been supported by the results of the classic ensilage cutter tests by Duffee(2)* in 1924 and 1925 using corn silage. However, in a recent study of paddle shapes, Raney and Liljedahl(4) found that the performance of a blower was improved by increased tip-clearance when blowing 67 percent moisture forage, cut to a theoretical length of ½ in.

Results of tests conducted at Iowa State College in the fall of 1956(3), with chopped alfalfa hay, strongly indicate the desirability of a relatively large paddle tip-clearance. It is the purpose of this paper to report the results of these tests and to present some evidence pointing to a major cause of the large power requirement of the forage blower.

Equipment and Instrumentation

A John Deere model 50 blower was modified for use as a test blower. Its 34-in.-diam housing was made circular and concentric to the impeller shaft so that a uniform tip-clearance could be maintained. The conventional front and back panels were replaced by ½-in. thick "Plexiglass" to allow observation of operation. The four straight paddles, which had a 7-deg backward slant, were made movable by making slots of the four bolt holes, through which the paddle arms were attached to the flywheel. A set of metal gage blocks was machined in increments of 1/32-in. thickness. By means of the slotted paddle arms and the gage blocks, the paddle tip-clearance could be adjusted over a range of 1/32 to ½ in.

Four SR-4 strain gages were mounted on the blower shaft for torque measurement. A mercury-bath collector unit completed the electrical circuit to a Brush BL 320 analyzer and BL 222 recording oscillograph. An event marker, actuated by a set of breaker points on the blower shaft, made a record of blower speed on the oscillograph chart.

The blower was driven by a flat belt from a Cockshutt model 40, 6-cylinder, diesel tractor. The feed rate was varied to any desired constant value by uniformly distributing a weighed quantity of hay over a 20-ft length of raddle-type conveyor, driven independently of the blower. The blower discharge pipe was 8 in. in diameter. The pipe height, to the top of a 180-deg deflector, from the center of the blower was 27½ ft. Part of the test setup is shown in Fig. 1.

Power-Requirement Tests

Three series of tests were run with feed rate and no-load blower speed constant, varying only the paddle tip-clearance. All tests were with alfalfa hay chopped to a theoretical length of 3 in. For the first series of tests, the hay moisture content was 18 percent. Blower speed was 800 rpm and feed rate was 20.6 tons per hour. Three runs were made at each of the following tip-clearances: 1/32, 1/16, ⅛, ¼, ⅜ and ½ in. The change in paddle-tip velocity with tip-clearance was small compared to the speed fluctuation of the blower.

The second series was run at the same blower speed but at a feed rate of 14.5 tons per hour. Hay moisture content was 23 percent. The same test procedure was followed at tip-clearances of 1/16, ¼, ⅜ and ½ in.

For the third series of tests, the no-load blower speed was changed to 750 rpm, but the feed rate was maintained at 14.5 tons per hour. Moisture content of the hay was 24 percent. Tip-clearances of 1/32, 1/16, ⅛, ¼, ⅜ and ½ in. were used.

Results

The results as shown in Fig. 2 represent the effect of paddle tip-clearance on the power requirement at two speeds and two feed rates. Each point is the average of three replications.

It is seen that, in all three series, the power requirement decreased sharply with increased tip-clearance. The rate of change of power requirement with tip-clearance was slightly higher at the higher feed rate.

Discussion

The greatest single contribution to the power requirement of this blower appears to be that due to interference of hay at the cutoff point and subsequent carry-over involving friction loss. The transparent sides on the blower housing permitted visual observation of the relatively large quantity of hay which was not released into the discharge pipe, but caught between the paddles and the cutoff point (Fig. 3). The sound of this violent action was also quite distinguishable. After passing the cutoff point, the hay was partly wedged between the paddle tips and the housing, resulting in a frictional force which in the extreme was sufficient to stall the blower.

Paper prepared expressly for AGRICULTURAL ENGINEERING. Journal Paper No. J-3369 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1195.

The authors—H. E. McLEOD and K. K. BARNES—are, respectively, graduate assistant and professor of agricultural engineering, Iowa Agricultural Experiment Station.

Acknowledgment: The authors express their appreciation to the John Deere Ottumwa Works of Deere and Company for equipment and assistance provided for this study.

*Numbers in parentheses refer to the appended references.

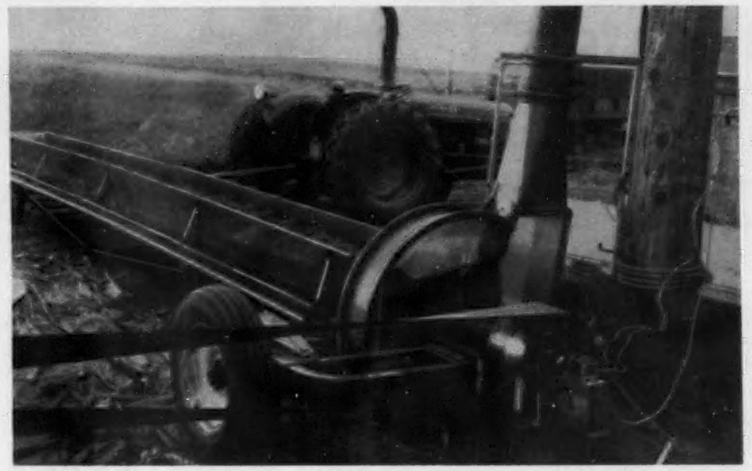
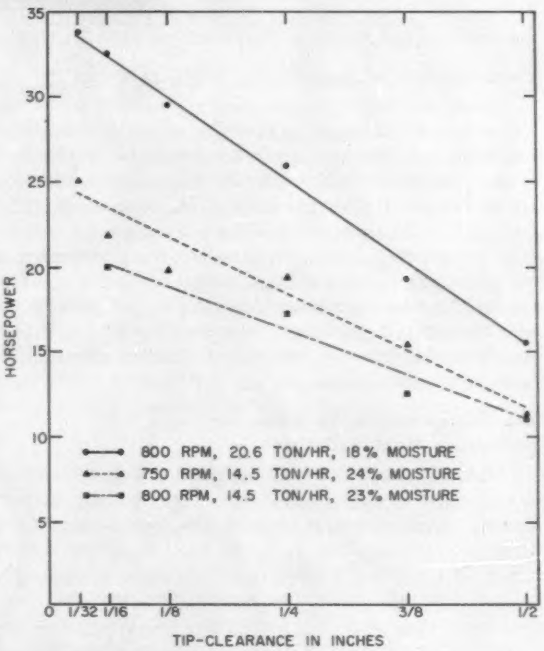


Fig. 1 *(Left)* Test blower with loaded feed conveyor

Fig. 2 *(Below)* Variation of forage-blower power requirement with paddle tip-clearance. Alfalfa hay, 3-in. theoretical length of cut



Carry-over of material appeared to be approximately the same for all tip-clearances. However, the larger clearances allowed more space for this hay to pass the cutoff point and in which to be contained as it was carried around the housing. This resulted in less energy absorption at the cutoff point and a smaller frictional force opposing the motion of the paddles. The torque curve on the oscillograph was considerably smoother at the larger tip-clearances. Also, the sound of the cutoff point interference decreased to a level which was barely audible at ½-in. clearance. A theoretical analysis similar to that reported by Blevins and Hansen(1) gave power requirements somewhat lower than the experimental values for a ½-in. tip-clearance. The difference was largely attributed to cutoff-point interference and carry-over. Since the theoretical requirement changed but little due to the changes in impeller radius, this difference was much greater at the smaller clearances.

It will be noted that, contrary to expectation, the curve for 750 rpm lies slightly above the curve for 800 rpm, both at a feed rate of 14.5 tons per hour. It is believed that this is due in part to increased interference and carry-over as a result of the decrease in kinetic energy imparted to the hay. For this speed reduction of 50 rpm, a particle leaving a paddle tip would have 12.5 percent less kinetic energy than

(Continued on page 474)

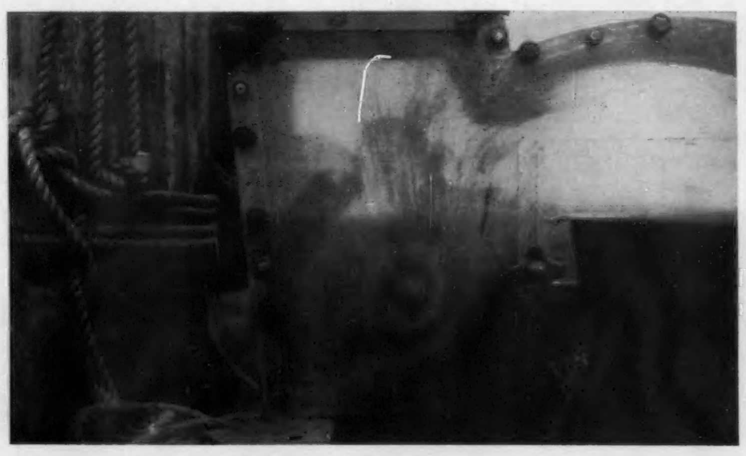


Fig. 3 *(Left)* Movement of hay through the blower housing showing cutoff-point interference

Evaluation of Factors in the Soil-Loss Equation

W. H. Wischmeier

D. D. Smith
Fellow ASAE

R. E. Uhland
Affiliate ASAE

Recent research provides new basic information for evaluating factors comprising the equation for estimating soil loss

SOIL-LOSS estimation by means of empirical equations is a basic step in the now widely accepted slope-practice method of determining conservation practices to be applied to specific fields. This paper presents recent developments which add to the research information currently available to serve as a basis for factors comprising the soil-loss estimating equation. Several of the major factors are examined in the light of these developments.

Consolidation of Runoff and Soil-Loss Data

A national program to assemble all available runoff and soil-loss data at a single location for standardization, summarization, and further analysis was initiated in the Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, in 1954. Basic data collected in the past three decades at 35 federal-state cooperative research projects have been assembled at the central runoff and soil loss statistical laboratory at Lafayette, Ind., and have been transferred to punched cards(13)*. The laboratory is operated in cooperation with the Purdue Agricultural Experiment Station and 20 other state agricultural experiment stations.

The Slope-Practice Equation for Estimating Field Soil Loss

The slope-practice equation for estimating the rate of erosion from a specific field area expresses the average annual soil loss in tons per acre as some base amount times a series of factors (2, 6, 8, 9, 10, 11, 12). These factors adjust the base loss for effects of differences in slope length, percent slope, soil erodibility, conservation measures, cropping and management. The factors are evaluated from actual measurements of soil and water loss on small experimental field plots.

Research and operations personnel in a regional workshop at Purdue University in July 1956 selected corn, spring grain, one-year meadow, with up-and-down-slope operation and only moderate soil treatments, as the base rotation for the slope-practice equation, to be adjusted to other rotations by means of a table of rotation indices (11). The slope-length, degree of slope, and soil erodibility factors were assigned unity values for the predominant plot length of 72.6 ft, a 9 percent slope, and Marshall soil, respectively.

The base soil loss thus defined averaged 8 tons per acre for 198 plot-years measured under this rotation in the north central states. The range of locations and years included in the study were assumed to provide a fairly representative sample with respect to timing of storms of different sizes relative to seedbed preparation and cover protection.

The Effects of Differences in Slope

Length of Slope. Zingg(15), in his study of the effect of length of slope on soil loss, concluded that soil loss per unit area varies as the 0.6 power of slope length. A group study in 1945 under the leadership of Musgrave(7) proposed 0.35 as the average value for the slope-length exponent for soil loss per unit area. The data from 15 studies in 9 states show a wide variation in values of the exponent. In a slope-practice group study at Purdue University in July, 1956, which included the authors, a slope-length exponent of 0.5 ± 0.1 was recommended for field use in the north central states.

A total of 532 plot years of data with simultaneous measurements on two or three lengths of slope under natural rainfall are available for statistical analysis of the relationship. Maximum lengths in two of the 15 studies were 270 ft and 630 ft, respectively. In the other studies the maximum was 145 ft. Due to physical limitations, studies utilizing simulated rainfall have been restricted to very short slopes.

Over-all analyses indicate that runoff is significantly affected by interaction of slope length with soil type. At the majority of locations, runoff did not differ significantly with plot length. However, in 15 years at Temple, Tex., and 17 years at Hays, Kan., a decrease in runoff with increased slope length was significant at the 5 percent level. For these two studies, the length-exponent for the soil-loss equation is zero. In 25 years at Guthrie, Okla., and in a 9-year study at Bethany, Mo., on virgin Shelby soil, runoff showed a significant increase with increased slope length. For these two studies, the length-exponent for soil loss estimation averages 0.74.

Soil-loss data from three replications of two plot lengths on each of four degrees of slope on Fayette soil at LaCrosse, Wis., show a significant interaction of length and degree of slope. However, because of the confounding of variables and lack of replications, it has not been possible to determine whether or not a similar interaction effect exists in the over-all data.

The relationship of soil loss to slope length often varied more from year to year on the same plot than it varied

Paper presented at the Annual Meeting of the American Society of Agricultural Engineers at East Lansing, Michigan, June, 1957, on a program arranged by the Soil and Water Division. (A contribution of the national runoff and soil-loss data summarization project of the soil and water conservation research division (ARS), U.S. Department of Agriculture, in cooperation with Purdue University Agricultural Experiment Station. Journal Series Paper No. 1119. Approved by the director.)

The authors—W. H. Wischmeier, D. D. Smith, R. E. Uhland—are, respectively, analytical statistician, agricultural engineer, and research specialist, Soil and Water Conservation Research Division (ARS), U.S. Department of Agriculture.

*Numbers in parentheses refer to the appended references.

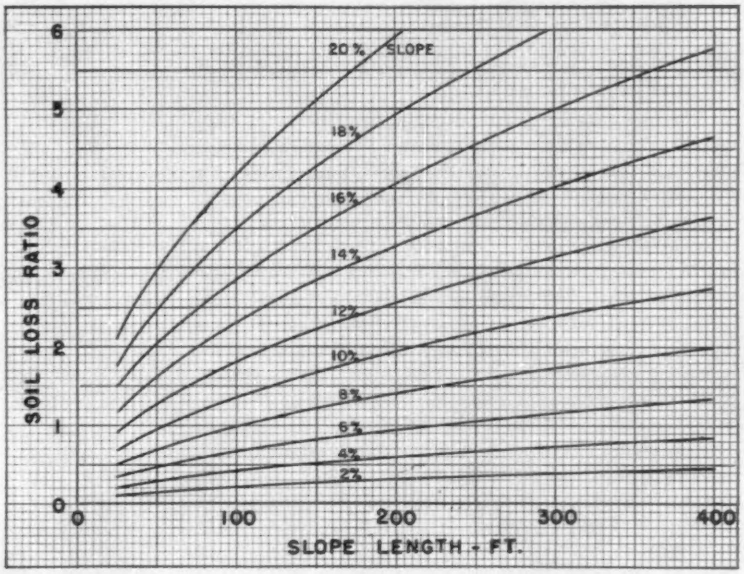


Fig. 1 Chart for adjusting plot soil loss to length and degree of slope

among locations. General trends were sometimes reversed in severe storms. The magnitude of the exponent appears to be influenced by storm size and soil characteristics, but extensive analyses on individual storm basis have not provided altogether satisfactory explanations of the storm-to-storm differences in the slope length-soil loss relationship.

Although slope-length exponents computed from each of the 15 sets of data vary rather widely, the differences in the average exponents derived from each of ten studies in the north central and northeastern states are not significant at the 10 percent level. The arithmetic mean of the ten exponents weighted by years is 0.46. For the studies in which field operations were up-and-down-slope, the average is 0.51; for across-slope farming, it is 0.42. However, the unexplained variance in these studies is large, and the difference between the two values is not significant. These analyses support the previously stated conclusion of the group meeting at Purdue University in 1956.

Percent Slope. Evaluation of the effect of percent slope on soil loss is complicated by three major weaknesses in the data: *(a)* Available data are too limited, *(b)* the slope effect is frequently completely confounded with the effectiveness of contouring which is itself believed to be a function of degree of slope, and *(c)* with few exceptions the range of slopes included in an experiment was too small to give a good indication of the type of curve that would best describe the relationship.

Available data lie within the 3 to 22 percent slope range. These data are somewhat more accurately fitted by a parabolic curve than by the exponential type. A recent manuscript by the authors(10) presented the equation

$$A=0.43+0.30S+0.04S^2$$

in which A is soil loss in tons per acre and S is percent of slope.

The family of curves in Fig. 1 indicates the appropriate factor for adjusting soil loss from "unity" plots to field-slope conditions. For example, the soil loss from an 8 percent slope averaging 290 ft in length is shown by the appropriate slope curve in the chart to be 1.7 times that from the 9 percent, 72.6-ft slope previously defined as unity.

Suppose an average annual loss of Y tons per acre has been measured or computed for some specific combination of practices on a 4 percent slope averaging 310 ft in length, and that it is desired to estimate the rate of erosion to be expected from the same cropping and farming practices on a field with a 10 percent slope 120 ft long. The ratio of the latter to the former (1.49/0.73) may be written directly from chart readings for the two combinations. Expected loss from the steeper slope would be Y times this ratio, or $2Y$ tons.

A Two-Equation Approach to Soil Loss Estimation

The rate of soil erosion from a field is influenced to various degrees by the characteristics of each individual rainstorm. The same storm characteristics appear also to influence some of the factor values in the slope-practice equation. In a comparison of annual average losses over a relatively short period, results may be significantly biased by effects of abnormal rainfall. Bias in measurement of treatment effects by extraneous variables is usually minimized in good statistical designs by randomization. But in soil and water loss studies, effective randomization over some of the extraneous variables may not be possible because of physical and economic limitations. For example, for soil factor evaluation, it would be difficult to find a range of major soil types within an area compact enough to have identical rainfall.

If the erosion-producing characteristics of individual rainstorms can be identified and their effects evaluated, these characteristics may be included as additional variables in a soil-loss estimating equation based on individual-storm data. The rate of erosion from a field is influenced by a large number of factors, the effects of some of which are additive while others are of a multiplicative nature. Combination of the two types of effects into a single equation would seriously complicate the use of least-squares procedures.

. . . Soil-Loss Equation

This difficulty is overcome by the use of a two-equation approach to soil-loss estimation.

The first equation combines the additive effects of rainfall characteristics, antecedent moisture, compaction by prior rains, and the interactions of these factors to estimate the soil loss associated with a specific rain falling on a plot devoid of cover, soil treatment and management effects. In other words, equation [1] computes the soil loss to be expected from a specific rain falling on untreated fallow with tillage operations comparable to row crops.

The second equation is similar to the slope-practice equation previously described. However, it now expresses soil loss in tons per acre for one specific storm. The base value of 8 tons is replaced by the soil loss computed in equation [1], and a factor evaluating the effect of the cover and rotation on the plot at the time of the storm. With the base value computed from rainfall data in equation [1], and the values of some of the other factors known from other studies, additional factors may be evaluated one at a time by solution of equation [2]. Thus the effect of storm size on the value of the factor under study may also be investigated.

Predicting Soil Loss Under Fallow Conditions

Individual storm runoff and soil-loss data are available for extended periods of continuous fallow at many of the locations where soil and water management studies have been conducted. The fallow plots received tillage operations comparable to plots in continuous row crop. These data served as the basis for extensive exploratory multiple regression analyses designed to identify the rainfall characteristics which influence erosion, and to evaluate combinations of rainfall characteristics and antecedent conditions as estimators of soil loss from fallow. Special emphasis was directed to detection of significant interaction effects. More than 40 factors and interaction terms were investigated.

Use of an electronic computer permitted the study of a large number of variables in a single equation. Coefficients of determination obtained with various subsets of fewer variables were then compared with the highest coefficient obtained. Some of the highest R^2 values for small subsets of variables are tabulated in Table 1.

A New Rain Parameter. A single parameter to describe the relative erosion-producing capacity of individual rainstorms is highly desirable for storm classification in analyses. The variable found to be outstanding as such a single measure is the product of the rainfall energy and maximum 30-min intensity of the storm. This term measures the interaction effect of these two storm characteristics and will be referred to as the $E \times I$ variable. In each of seven sets of fallow-plot data analyzed, a simple linear regression on this one variable accounted for a greater portion of the total storm-to-storm variation in soil loss than did a multiple regression on rainfall amount and maximum 5, 15, and 30 min intensities.

The ability to predict soil loss is considerably improved by this new parameter, and the cost of computing multiple-regression equations is reduced by the fact that one variable affords more information than four or five variables which would otherwise need to be included in the equation.

TABLE 1. PERCENT OF TOTAL SOIL LOSS VARIATION EXPLAINED BY VARIOUS FACTORS AND COMBINATIONS (R^2)

Soil type:	Shelby[1]	Shelby	Shelby[2]	Marshall[2]	Fayette
Location:	Bethany, Missouri			Clarinda, Ia.	La Crosse, Wis.
Percent slope:	8	8	8	9	16
Years of data:	10	10	10	7	6
No. of observations:	138	207	207	131	144
Variable(s),	R^2	R^2	R^2	R^2	R^2
Precip. amount	73.0	68.3	64.6	38.7	42.2
Rainfall Energy	81.7	78.2	73.9	54.9	61.6
15-min max. intensity	43.4	40.9	25.7	50.4	65.5
30-min max. intensity	56.2	59.8	35.1	56.0	79.9
Precip. amt., 15-min intensity and 30-min intensity	78.6	73.8	67.6	66.2	82.6
Interaction of $E \times I$	89.2	81.7	75.6	70.7	88.0
Four Variables[3]	92.1	85.8	80.2	78.6	88.3

[1]Rough-plow winter period excluded.
[2]Seven inches of topsoil mechanically removed.
[3]Rainfall energy, energy times 30 min intensity, total rainfall energy since last tillage of the soil, and antecedent precipitation index.

The New Equation. Little is added to the accuracy by combining rainfall amount and maximum intensities with the $E \times I$ variable in multiple regressions. Accuracy of the prediction equation is improved, however, by combining with the $E \times I$ variable in a multiple regression, a measure of rainfall energy and indices of soil moisture and surface compaction by rainfall. Correlation coefficients ranging from 0.89 to 0.96 were obtained from the five groups of data of Table 1 in the model:

$$Y_c = b_0 + b_1 X_e + b_2 X_i + b_3 X_p + b_4 X_c$$

where Y_c = computed soil loss, T/A

X_e = energy of the rain in foot-tons per acre

X_i = X_e times maximum 30-min intensity in inches per hour

X_p = antecedent precipitation index. (Antecedent net precipitation with daily between-rain reductions varied according to season)

X_c = accumulated rainfall energy since last tillage of the soil.

Least-squares evaluations of the coefficients in this equation are as follows for the soil groups of Table 1, taken in sequence from left to right:

Group No.	b_0	b_1	b_2	b_3	b_4
1	−2.46	.00163	.00389	.439	.0622
2	−3.10	.00353	.00268	.792	.0452
3	−2.88	.00317	.00195	.320	.0407
4	−1.63	.00036	.00439	.106	.0518
5	−1.24	−.00074	.01040	.035	.0383

The results of this mathematical analysis are consistent with the basic principles of erosion (14). The $E \times I$ term appears to be a good measure of the combined effects of *(a)* the decreasing infiltration rate during a rain, *(b)* the exponentially increasing erosion effect of surface flow, and

(c) the protection against raindrop splash which is afforded by the film of flowing water. The antecedent precipitation index in the equations affords a measure of the point on the time-infiltration rate curve at the beginning of the rain. Total rainfall energy since last cultivation provides a measure of the effects of surface compaction by prior rains, reduction in surface detention due to leveling of the surface by splash erosion, and sealing of the land surface.

Inaccuracies in wintertime indices of soil moisture and compaction and failure to measure the effect of freezing and thawing tend to lower the estimating efficiency of an equation based on year-around data.

Computing Rainfall Energy. The importance of rainfall energy in estimating soil losses, calls for a routine procedure for obtaining a measure of the total kinetic energy imparted by the countless raindrops comprising a storm. Published data and literature show that, in natural rainfall, drop-size distribution is highly correlated with intensity. An energy equation was derived by the authors(14) from published data on drop velocity by Gunn and Kinzer(3), and by Laws (4), and on drop-size distribution by Laws and Parsons(5). The equation, $KE = 916 + 331 \log_{10} I$, expressing kinetic energy in foot-tons per acre-inch as a function of rainfall intensity in inches per hour, is the basis for Table 2.

To compute the energy value of a rainstorm, Table 2 is used with the information available from a recording rain gage chart. A tabular record of intensities, with the amount of rain falling in each of the successive intensity increments, is obtained from the recorder chart. The table is entered with the midvalue of a specific intensity increment. The corresponding energy figure from the table multiplied by the inches of rain falling at this rate describes the energy value of the increment of the storm. These partial products are accumulated to obtain the total energy value for the storm. The rain gage chart must be carefully read so as not to average high intensities with low ones.

In many instances the amount, duration, and maximum 5, 15, 30, and 60-min intensities have already been tabulated in the station records. If a rain has a single high-intensity period, this information will suffice for a fair estimate of rainfall energy. The recorded information is used to compute amounts and intensities for 5, 10, 15, and 30-min periods which are mutually exclusive and a fifth intensity which is the average for the remainder of the storm. Analyses as a part of this study show that energies computed by this method will be slightly biased and should be multiplied by a factor of 1.04 to place them on an equal basis with evaluations from detailed readings of the rain gage chart.

TABLE 2. KINETIC ENERGY OF NATURAL RAINFALL

(Foot-tons per acre-inch)

Intensity, in/hr	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0	—	254	354	412	453	485	512	534	553	570
.1	585	599	611	623	633	643	653	661	669	677
.2	685	692	698	705	711	717	722	728	733	738
.3	743	748	752	757	761	765	769	773	777	781
.4	784	788	791	795	798	801	804	807	810	814
.5	816	819	822	825	827	830	833	835	838	840
.6	843	845	847	850	852	854	856	858	861	863
.7	865	867	869	871	873	875	877	878	880	882
.8	884	886	887	889	891	893	894	896	898	899
.9	901	902	904	906	907	909	910	912	913	915
	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1	916	930	942	954	964	974	984	992	1000	1008
2.	1016	1023	1029	1036	1042	1048	1053	1059	1064	1069
3.	1074	1079	1083	1088	1092	1096	1100	1104	1108	1112
4.	1115	1119	1122	1126	1129	1132	1135	1138	1141	1144
5.	1147	1150	1153	1156	1158	1161	1164	1166	1169	1171
6.	1174	1176	1178	1181	1183	1185	1187	1189	1192	1194
7.	1196	1198	1200	1202	1204	1206	1208	1209	1211	1213
8.	1215	1217	1218	1220	1222	1224	1225	1227	1229	1230
9.	1232	1233	1235	1237	1238	1240	1241	1243	1244	1246

Applications for the New Equation

Cropping and Soil Management Practice Factors. Four methods commonly employed to handle the effects of extraneous variables in statistical designs are rigid control, randomization, classification, and analysis of covariance procedures. In the case of the effects of differences in rainfall pattern, the new rain parameter, $E \times I$, with its high runoff and soil-loss prediction value, provides a means for employment of either of the latter two methods. It will serve as a basis for classifying storms according to their erosion-producing potential and will serve as a concomitant variable in analysis of covariance.

The soil-loss estimating equation for fallow soil, derived on the basis of four readily measured variables, provides a theoretical common check plot which in some instances makes it possible to compare data otherwise incomparable because of differences in time periods or physical location.

Soil Erodibility Factor. Due to the physical and economic aspects involved in experiments to evaluate soil-erodibility factors, soil effects are usually automatically confounded with the effects of differences in rainfall occurring in the different geographic regions. The approach developed in the preceding sections appears to be quite valuable in segregating the two effects to compute independent numerical values for the soil factor and for the rainfall factor.

Detailed precipitation records and soil-loss data are available for fallow plots on various soil types located in different geographic regions. If all the fallow plots receive up-and-down slope tillage similar to that for row crops, and the data are adjusted to a common slope base, differences in measured rates of erosion are a measure of the combined effects of differences in soil and rainfall. Soil-loss estimating equations based on the four measured variables listed in footnote 3 of Table 1 may be derived for the various soil types. A single rainfall pattern may then, in effect, be superimposed upon all the plots by substituting the pertinent measured characteristics for each storm into the estimating equations which have been derived for the several soil types. The result is a good estimate, with calculable error, of the erosion which would have been measured at each location under the fallow conditions had this been the rainfall pattern over all the regions. Differences in these calculated erosion rates are then a measure of soil erodibility, independent of rainfall effects.

A test for interaction effects was made by applying to four soil types a set of hypothetical precipitation data which included all combinations of three levels of each of the four variables on which the prediction equation is based. The test detected no significant interaction of soil type and rainfall characteristics.

. . . Soil-Loss Equation

The procedure applied to the actual data for the soil groups and years of record included in Table 1 yielded the following soil factors:

Marshall, desurfaced (Clarinda, Ia.)	1.00
Shelby, moderately eroded (Bethany, Mo.)	1.20
Shelby, desurfaced (Bethany, Mo.)	0.85
Fayette (La Crosse, Wis.)	1.07

These analyses indicate that the relatively high soil losses measured at La Crosse as compared with those at Clarinda and Bethany were the result of effects of slope and rainfall differences rather than differences in erodibility of the soils. The analysis will be extended to include other soil types for which data are available.

Rainfall Factor. Relative rainfall factors for the period of plot measurements may be evaluated by an extension of the procedure developed for determining soil erodibility. For example, it was found that the equation based on four variables estimated the true mean soil loss for a specific storm at Bethany within a very narrow confidence band. If now the values of these four variables as they were measured at La Crosse are substituted in the equation developed for Bethany, the cumulative result is a good estimate of total soil loss that would have occurred had the La Crosse rains fallen on the Bethany plot. When both soil loss totals are converted to annual averages, the difference between the two is a measure of the effect of rainfall differences. By this procedure, the following relative rainfall factors were derived for four locations, using the Clarinda, Iowa, station rainfall for 1933-39 as unity:

Location	Years of Data	Rainfall Factor
Clarinda, Ia.	1933-39	1.00
Bethany, Mo.	1931-40	1.35
La Crosse, Wis.	1933-38	1.54
Lafayette, Ind.	1944-53	1.74

When these rainfall factors are combined with the soil factors of the preceding section and with the applicable slope and contouring factors, the product of the factors for each location very closely approximates the ratio of the average annual soil loss measured from the fallow plot at that location to the average annual loss from the Clarinda plot.

The relative factors tabulated above apply only for the respective short-time periods indicated in the tabulation. They are helpful in analyzing differences in soil losses measured at the various locations, but are not the *normal* factors for these localities. Also, the value of a factor in the slope-practice equation which evaluates the relative *annual* rainfall erosion potential is limited to comparisons of erosion at locations with identical distribution of rainfall by seasons of the year. For general field application, rainfall factors will need to be evaluated on the basis of seasons corresponding to different stages in crop development.

Derivation of relative seasonal rainfall erosion index values for specific localities from long range Weather Bureau data is planned. Availability of normal rainfall factors and soil factors will enhance the accuracy of the slope-practice technique.

Summary

Recent developments add to the information available to serve as a basis for factors comprising the soil-loss estimating equation.

The exponent for length of slope in the soil-loss estimating equation was analyzed on the basis of 532 plot-years of data assembled at the central soil and water loss data statistical laboratory at Lafayette, Ind. The magnitude of the exponent varies considerably from year to year as well as between locations. It appears to be affected by an interaction effect of slope length and soil type on runoff. Differences in the slope-length exponents measured for contour and with-slope farming and differences measured between locations in the north central and northeastern states are not significant at the 10 percent level. For these regions, 0.5 appears to be a good conservative estimate of the over-all average value for the length exponent.

The percent slope-soil loss relationship should be studied in new field tests without contouring, on as many slopes as physically possible. Very limited available data indicate a parabolic relationship for slopes under 20 percent. However, it is quite possible that the shape of this curve was influenced by the fact that most of the data are from plots with cultural operations on the contour. The effectiveness of contouring is generally considered to be a function of percent slope.

A family of curves in Fig. 1 presents the appropriate factors for adjusting soil-loss data for differences in length and degree of slope.

A single-storm, two-equation approach to soil loss prediction is presented as a means of minimizing bias in soil loss data due to significant differences in the characteristics of individual rains. Extensive analyses of fallow-plot data to evaluate the effects of rainstorm characteristics on soil and water loss yielded a *new rain parameter* which appears to be quite efficient as a basis for classification of storms according to erosion-producing potential. The parameter is the product of the rainfall-energy and maximum 30-min intensity of a storm. A table of rainfall-energy values associated with rainfall intensities is presented to facilitate computation of the new parameter.

Soil erodibility and rainfall factors may be evaluated independently by employment of the new relationships provided to segregate soil and rainfall effects. This greatly enhances the utility of plot data in geographic regions other than where the field studies were conducted. The procedure is illustrated in a partial study in which erodibility factors for four soils and rainfall factors for four locations are numerically evaluated. The study will be extended to other soils and localities.

A similar approach is feasible in the analysis of runoff data.

References

1 Agricultural Research Service-Soil Conservation Service, and Agricultural Extension Service. Conference on slope-practice values. Purdue University, Lafayette, Ind., February 27-March 1, and July 19-20, 1956. Processed.

2 Browning, G. M., Parish, C. L. and Glass, J. A. A method for determining the use and limitation of rotation and conservation practices in control of soil erosion in Iowa. Jour. Amer. Soc. Agron. 39:65-73 (1947).

(Continued on page 474)

Land Leveling for Drainage and Irrigation

Richard L. Phillips
Assoc. Member ASAE

Land leveling to provide, in one system, both surface drainage and surface irrigation of Missouri River bottom land gives farmers double insurance—against the hazards of either a wet or a dry year

IRRIGATION has moved into western Iowa and, along with it, some of the best surface drainage practices known to man. Surface drainage has long been a problem in this area—the Missouri River bottom land. The danger of flooding from the river itself has been virtually eliminated since the installation of the large mainstream reservoirs in the Dakotas. Since the summer of 1953, moisture has been short. This, plus the fact that irrigation has been practiced for years just to the west in Nebraska, has prompted many landowners to invest in manmade methods of watering their crops on this wide valley floor.

Land-Leveling Activity

Land-leveling activity has increased by leaps and bounds in the last few years. Harrison County, on the western border of Iowa adjacent to the Missouri River and about midway in the state from north to south, is a good example. Its floodplain is 5 to 15 miles wide. It is underlain by a plentiful supply of water. Water is pumped at shallow lifts from wells 80 to 100 ft deep. The first leveling projects were in 1954. One job covered 60 acres and was done for drainage alone. In 1956, sixteen land-leveling jobs covering 834 acres were completed. This activity is increasing.

Topography and Soils

The land on the Missouri River bottom is rather flat. It has numerous depressions and swales typical of river overflow land. Land adjacent to the river has a fall of one foot per mile and less, while the land farther away will have a fall varying from 5 to 10 ft per mile. At the edge of the bottom, the topography changes to heavy rolling. Runoff from the hill land is discharged onto this floodplain, and crops are repeatedly damaged by poor drainage, upland runoff, and flooding. The soils are variable, ranging from the sandy loams to the clays, but the majority are fine-textured. Most of the work to date has been on the silty clays and clays, which need surface drainage the most. These heavier soils in times of excess moisture take water very slowly after the initial absorption. The water accumulates on the surface and then moves to the depressional areas. Tile drainage has not been used to any extent because many of the soils contain up to 65 percent clay.

Rainfall

Rainfall, which affects any plan for drainage and irrigation, varies from 20 to 35 in. at Council Bluffs, Iowa. The average is 27.8 in. There is a tendency for an excess of moisture in the spring, and a deficiency in July and August. This results in late plantings and poor stands early in the year, while later the same crop may suffer from lack of moisture. The author has seen many fields late in the summer where a portion of the crop would be missing or growth reduced from being "drowned out" early in the season. Yet a short distance away the crops that had escaped the earlier fate were withering from lack of moisture.

Drainage

Over the years much effort has been expended on outlet drainage ditches. These channels were excavated to carry the hill runoff across the valley floor to the river and to provide outlets for farm drainage. They were usually installed as legal ditches. The use of shallow ditches to provide surface drainage for the land has developed slowly. Only recently the need for good surface drainage has been recognized. Past practice has been to extend the shallow drains into the low areas and depressions. On particularly hummocky fields this has resulted in ditches at all angles and at all distances apart. Even then the drainage has not been good because of the many small 1 or 2-in. depressions between ditches and the inability of all of the surface water to get into the ditches. Also, the convenience of farming has suffered.

Surface Irrigation

The series of dry years recently experienced emphasized the need and value of irrigation. The soils and topography lend themselves to the use of surface irrigation, but land leveling of these soils is necessary for the development of that type of system. The major crop grown in the area is corn. Some soybeans are grown. Both are grown and cultivated as row crops. Land leveled to a uniform slope irrigates easily and automatically provides the highest degree of surface drainage, as each crop row will drain throughout its entire length. All that is necessary to complete the drainage system is a shallow collection drain at the ends of the rows. These drains also serve during irrigation to carry away any excess water from the lower end of the field. The combined drainage and irrigation system has been installed on many farms on the Missouri River bottom. Farmers figure this as a sort of a double insurance program against the hazards of either a wet or a dry year. It is easy to see that here in the humid area an all-inclusive drainage system is the most important part of a complete irrigation system. Many farmers have expressed the opinion that irrigation could be used approximately nine out of ten years. The year 1957, one of above normal moisture, has confirmed this. Many are no longer satisfied with the yields that come

Paper presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1957, on a program arranged by the Soil and Water Division.

The author — RICHARD L. PHILLIPS — is area engineer, Soil Conservation Service, U.S. Department of Agriculture.

. . . Land Leveling

from normal moisture which, for the main crop, corn, is 60 to 80 bu per acre. Now, using complete drainage and irrigation systems and modern fertilizers, they are aiming at 100 to 120 bu. And they are reaching it, too.

Yields

On the Don Anderson farm, Honey Creek, Iowa, the average increase from irrigation for 1955, an exceptionally dry year, was 80 bu of corn per acre. In 1956, the increase was 55 bu, from 60 to 115. On both the Vern Williams and the R. M. Martens farms near Missouri Valley, Iowa, yields have been measured at 135 bu. Increased yields due to drainage are less easily defined because most of the farmers having drainage systems are also irrigating. With the exception of the current year, moisture has been subnormal, making it difficult to compare. It is estimated that for this year the yield increase should be from 20 to 30 percent, based on better stands alone. Other benefits include earlier planting in the spring and less replanting.

Design Criteria

Farmers desiring technical help with their leveling projects have turned to the U. S. Soil Conservation Service for assistance. Most of the layouts are in two categories. In one, the field is graded so the center is high. Drainage is from the center to ditches along the field boundaries (Fig. 1). This works particularly well where the length of run is 660 ft because in a 40-acre field no ditches will fall inside the field. It also is a very convenient layout to use on an 80-acre field when the peak or ridge of the field runs the long direction. This places the drains 660 ft from the center along the boundaries of the field. The well is then located at the center, and 1320 ft of gated pipe is sufficient to carry water to each row. Over 90 percent of the systems so far have used gated pipe for supply.

The other layout used is a continuous slope in one direction with cross-slope ditches at the required interval (Fig. 2). This adapts itself to lands with an existing continuous slope. It requires less earthmoving than the first method. It does not irrigate as easily and requires more drains. With those who have leveled more than one piece of ground, the first system is definitely preferred, even if it means reversing a slope. Most of the leveling is being done for a cost of $50 to $70 per acre.

In the design of the system, one of the first things to be decided is the length of row. Several factors control the length of row, namely, drainage criteria, economics, intake rate, and the maximum non-erosive stream, which is itself a function of slope. On bottomland with flat design grades, if the row length is too long, there will be a build-up of runoff water at the lower end and drainage will be slowed down. Accordingly, the Soil Conservation Service has set up a tentative guide for this area for the row lengths. Collection ditches are designed at the end of each row to carry the discharge from the field.

Intake rate also controls the length of row. The higher the intake rate, the shorter must be the length of run to provide efficient surface irrigation. From the drainage standpoint, the opposite is true. For example, light-textured soils having their own internal drainage often do not need surface drainage and could have long lengths of run, if for drainage alone. But, in a combined system, the rows must be shorter to irrigate efficiently. For the moderately light-textured soils, the length has been set at 950 ft. On the medium-textured soils, the length for irrigation exceeds that for drainage, so here again the length is cut. It has been made 1,000 ft.

The fine-textured soils of the Missouri River bottoms are in a category all their own. Of particular interest are the Luton and Albaton clays, both having a clay content of 60 to 65 percent. In this area, these two soils need surface drainage the most, and are the ones that suffer the most crop damage in wet years. For drainage, the row length should be short. For irrigation, it was originally thought that the row length could be quite long, due to the slow intake rate. This theory was soon proved wrong by the first irrigators in the area. These soils, when not saturated, crack quite badly —some up to 6 ft deep. As a result, they take irrigation water readily, behaving like the sands. Accordingly the length of row for these has been set at 700 ft.

Both the slope and length of row are affected by the maximum non-erosive stream. This stream has been calculated to be the number 10 divided by the slope in percent; e.g., a bare furrow on a 0.2 percent slope would handle safely 50 gpm. As can be seen, this stream size varies inversely with the slope. If we have a soil that is light and has a high infiltration rate, we will want to use a high initial stream. The flatter we grade the land, the greater flow we can safely discharge into the furrow without causing erosion, and thus the greater the length of run.

The minimum slope requirement for drainage is 0.05 percent. The minimum slope used so far is 0.1 percent, but farmers who have leveled more than one piece of ground prefer a slope of 0.2 percent. This helps to offset many of the small depressions that settle after the job is

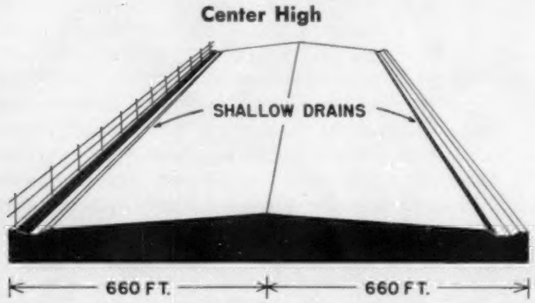


Fig. 1 *(Left)* Field graded for drainage and irrigation with center high and drains along boundaries

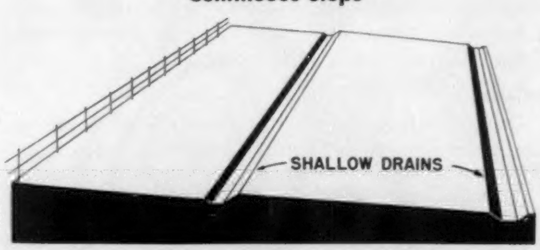


Fig. 2 Field graded for drainage and irrigation with continuous slope in one direction with drains at required intervals

Two Planes

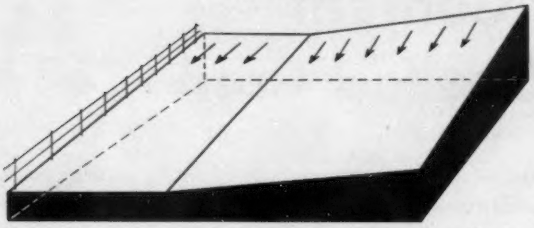


Fig. 3 Field graded in two planes, each with the same degree of row slope but with one plane having cross slope and the other with no cross slope

finished. Seldom do jobs on this flat floodplain exceed a maximum slope of 0.25 percent.

Economics enters into each job in different degrees and has to be decided individually. The fields being graded are so flat that slope must usually be created by cutting at the lower end and filling at the upper. Obviously, the longer the haul or the heavier the cut, the more the expense. Since the longer rows involve longer hauls and usually greater cuts, the cost per acre can double that of the shorter length. This is offset somewhat by the lesser number of drains. About one-third of the expense involved in the total job is the excavation of the drains. This is because the material usually is hauled the entire length of the row. Drains are a good investment for they will be used every year, whether wet or dry.

Plane Method of Design

Confronted in the summer of 1955 with a large number of land-leveling jobs to survey, design and install, the first thing done was to cast about for a method to expedite the work. Several methods were tried—the profile method, the contour-adjustment method, the plan inspection, and the plane method. It was decided to use the plane method, especially since the land is so flat. It is the further intent of this paper to give some of the experience gained in using this method on flat land leveling, and to explain the use of profiles to determine size of planes and to best fit the plane to the land.

The first step was to stake the field in a 100-ft grid system, usually of rectangular coordinates. Rod readings were taken and recorded at ground level of all stakes. At the same time, information was obtained on pertinent elevations of outlet ditches and culverts. The next job was plotting the information on cross section paper. Here the designer must make a decision—should he work with rod readings, or should he use elevations? Our choice was to use rod readings because this simplifies the procedure on very flat land. On steeper land, elevations are usually used. On large fields, it was necessary to convert all rod readings to one common H. I. Most of the projects involved less than 5 ft total difference in elevation, and usually only 1 or 2 ft.

Use of Profiles to Determine Width of Plane and Cross Slope

The first step in the office after plotting was to determine the size of the plane. The entire field, whether several acres or several hundred, can be graded to one plane by this method if so desired. Unless the field is rather small, or is very uniform, this will not be the best solution because there will be additional cost resulting from heavy cuts and extra cross haul. Since most fields have varying slopes, it is usually advantageous to break the large field into smaller planes in order to more closely fit the prevailing conditions (Fig. 3). To help determine the number of planes to use, some average profiles were plotted giving the natural lay of the field. These profiles are easy to plot and have been a great time-saver. Some engineers sketch contours to study the field as to breaks. However, on this type of topography, contours are difficult to plot and are sometimes confusing.

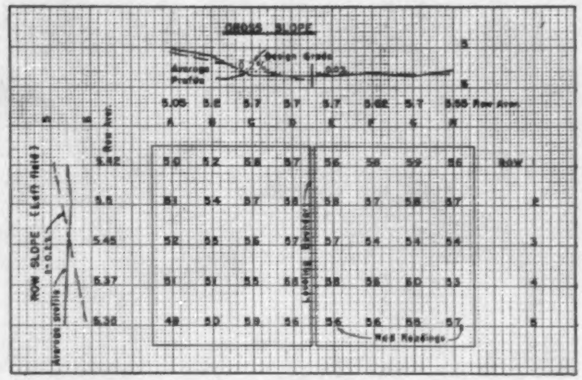


Fig. 4 Land-leveling layout

To start, a direction of flow and a tentative length of plane were assumed. The length is generally controlled by irrigation or drainage requirements. The cross slope, which is at right angles to the direction of flow, was called the horizontal direction. The direction of the rows was called the vertical direction. First, the rod readings were added for each row in the vertical direction, the average was found, and this figure written directly above its row (Fig. 4). This is not wasted effort since the sum of all the rod readings in the field will be needed later. Then, in the space above, the average rod readings were plotted in a profile along the edge of the sheet, using an inverted scale. We then analyzed the plotted profile for breaks in grade. At these larger breaks, one design plane stops and another starts. At this point of the design, there is no substitute for experience. Fig. 5 shows

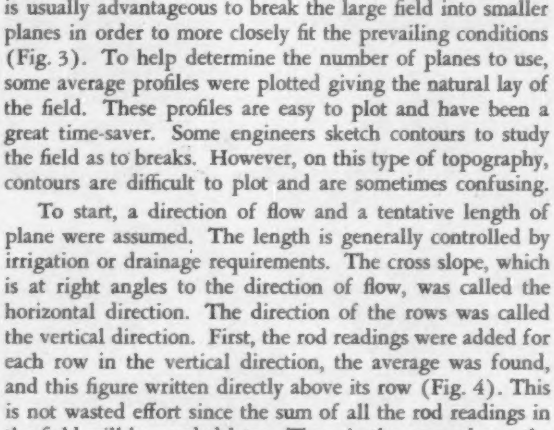


Fig. 5 Average profile used in analyzing cross slope and in fixing boundaries of the design plane

another profile which tends to slope constantly downward from row 1 to row 10, levels off from 11 through 14, and then slopes downward again. This indicates that it will be more economical to design this job as three smaller planes if we meet criteria as to maximum cross slope. This will eliminate excessive cross haul.

The next step was to determine the cross slope to be used in the design. This can be done several ways, one of which is the plane-of-best-fit method. However, the profile already plotted gives this directly; simply figure the slope of the average line through the profile for the particular plane.

(Continued on page 470)

Equilibrium Moisture Content of Shelled Corn

Carl W. Hall and
Member ASAE

Jorge H. Rodriguez-Arias
Member ASAE

Attention is directed to the great dearth of basic information on equilibrium moisture-content relationships in drying shelled corn, with emphasis on experimental evidence obtained

MOST crop drying information has been developed from field tests and is of an empirical nature. There is need for extensive, fundamental research data on moisture movement in shelled corn. This need has been accentuated by the trend toward increased use of heated air in drying. Most of the present available data concerning equilibrium moisture content (hygroscopic equilibria) of corn have been the result of work performed before heated-air drying was extensively used. Consequently there is a great dearth of basic information pertaining to the equilibrium moisture-content relationships of the drying process in the range of temperatures usually employed while drying with heated air.

Objectives

1. To investigate the applicability to equilibrium moisture-content data expressed as desorption isotherms of various isotherm equations and theories in an attempt to explain the nature of the water-binding mechanisms in shelled corn.

2. To obtain experimental evidence of the validity of Henderson's equilibrium moisture-content equation in correctly describing the temperature dependence of desorption isotherms.

Terminology

Isotherm. A curve resulting from plotting the equilibrium moisture contents on the ordinate and the respective relative humidities on the abscissa. These equilibrium relationships are obtained at a constant specified temperature and designated as an isotherm.

If water is added to the grain while approaching equilibrium, the curve is referred to as a sorption isotherm; or if the water is removed from the grain in approaching equilibrium, it is called a desorption isotherm. Desorption phenomena are applicable for drying while adsorption or sorption data are more generally applicable to problems in storage.

Equilibrium Moisture Content. The moisture content of the grain that corresponds to the relative humidity of the surrounding air after equilibrium has been established at a certain temperature. It is also quite frequently called the hygroscopic equilibrium of the material. The corresponding relative humidity is referred to as the equilibrium relative humidity for a particular moisture content and is often called the equilibrium relative pressure when expressed in decimal form.

Isotere. The relationship between the equilibrium relative humidity or equilibrium vapor pressure and the temperature plotted as constant percent moisture lines. The relative humidity or vapor pressure is represented on the ordinate and the temperature is represented on the abscissa. Isoteres can be conveniently plotted on a psychrometric chart.

Isopiese (isobar). The curve obtained when the percent moisture content is plotted against the temperature for constant vapor pressures.

In water-grain relationships, the dried grain is considered as an adsorbent and the water, whether in the liquid or the vapor phase, is the adsorbate. When there is a relatively weak interaction between adsorbent and adsorbate involving only forces of the order of magnitude of those active in condensation phenomena, the adsorption is called physical or van der Waal's adsorption. It is now generally agreed that it is this type of adsorption that is almost wholly concerned in grain-water relationships.

Types of Isotherms

Various types of isotherms are presented in the literature. In 1940, Brunauer and his co-workers(2)* proposed a classification of isotherm types which has been widely adopted by other investigators. Their classification includes five principal types according to shape and characteristics. They are designated by roman numerals I to V. The type II isotherm has been called the S-shaped or sigmoid isotherm. Its shape has been generally attributed to multimolecular adsorption and is of considerable importance for cereal grains.

Useful Adsorption Theories and Equations

It is beyond the scope of this paper to delve into the adsorption theories in great detail. Two thorough discussions on the subject have been given by Brunauer and by DeBoer in their well-known books on adsorption(2, 6). The salient features of the most important and applicable theories of adsorption are presented as a background for understanding the material presented.

The B-E-T Theory of Multimolecular Adsorption. This theory was first postulated in 1938 by Brunauer, Emmett and Teller and is based on the assumption that the same forces that produce condensation are also responsible for the binding energy of multimolecular adsorption(3). The B-E-T theory constitutes the first attempt to present a unified theory of physical adsorption.

Paper prepared expressly for AGRICULTURAL ENGINEERING and partially based on a thesis for a Ph.D. degree by the junior author. Approved for publication as Journal Article 2298 of the Michigan Agricultural Experiment Station, July, 1958.

The authors—CARL W. HALL and JORGE H. RODRIGUEZ-ARIAS—are, respectively, professor of agricultural engineering, Michigan State University, and head, agricultural engineering department, University of Puerto Rico (formerly graduate research assistant, Michigan State University).

*Numbers in parentheses refer to the appended references.

In general, the two-constant B-E-T equation has been found to conform very closely for many adsorbents over the range of relative humidities between 5 or 10 to at least 35 percent, and sometimes to 50 percent. Outside of this range, the equation usually breaks down. Becker and Sallans obtained excellent correlation of desorption equilibrium data for wheat at 25 C (77 F) up to a relative humidity of about 35 percent(1). Hogan and Karon obtained reasonably good plots over a range of relative humidities between 10 and 40 percent for rice (12). These results favor the hypothesis that the water-binding mechanism predominating in cereal grains involves multimolecular adsorption, as postulated by the B-E-T theory.

Harkins-Jura Equation. The procedure developed by Harkins and Jura(10) provides a simple method for determining the surface area involved in adsorption. Good linear plots have been obtained in the range from 50 to 95 percent relative humidity when applied to water protein adsorption (8). This procedure provides a method for finding equilibrium values with great accuracy at the high relative humidity values.

Smith's Equation. Smith developed an equation which yields straight lines between relative humidity values of 0.5 and 0.95(14). It has essentially the same range of applicability of the Harkins-Jura equation. When Smith's equation was applied to desorption isotherms of wheat, essentially linear values were obtained in the range from 50 to 95 percent relative humidity(1). Becker and Sallans(1) noted that the B-E-T and the Smith equations complement each other as to their respective regions of validity. Becker and Sallans(1) suggested an interesting and valuable method of defining the intermediate linear region characteristics of the S-shaped isotherm. This is done by plotting the data according to both the equations on the same graph and drawing a line tangent to the Smith curve and intersecting the B-E-T curve at its point of inflection (Fig. 1). This procedure results in an excellent fit of the experimental data and gives a smooth, unbroken transition into the curved regions described by both equations.

Henderson's Equilibrium Equation. An isotherm equation was developed which could be used to account for the temperature dependence where certain k and n experimental constants characteristic of any given hygroscopic material were calculated by Henderson(11). While the equation appeared generally acceptable in describing the shape of the isotherm and fitting limited experimental data then available, Henderson himself cautioned against its general use pending further experimental confirmation of its validity.

Procedure

The corn used for determination of the equilibrium moisture data was yellow dent hybrid purchased during the fall of 1954 and stored at 40 F until tested. Saturated salt solutions were used to control the relative humidity. Closed containers with the grain sample above saturated salt samples were then set in temperature controlled boxes at various temperatures. The initial moisture content of the corn was 25.4 percent (dry basis). The samples were weighed periodically until constant weight was maintained, which was at least two weeks depending upon the temperature and relative humidity. All moisture contents were determined by using the air-oven method. Six different temperatures were employed for the tests, namely, 40, 60, 86, 100, 122 and 140 F, ± 1 F.

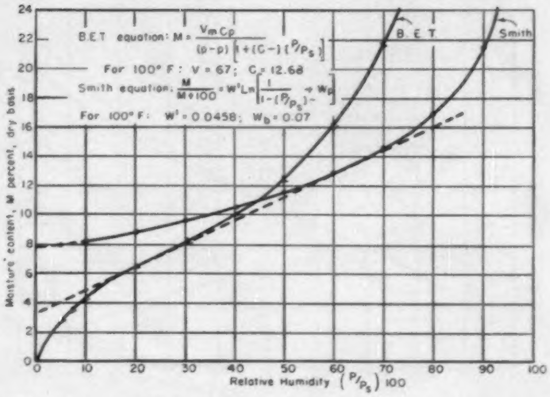


Fig. 1 Desorption isotherm of shelled corn at 100 F illustrating a method of obtaining the intermediate linear region

Results

The equilibrium moisture or hygroscopic equilibrium data for shelled corn as obtained in the experiments are shown in the form of isotherms in Fig. 2. The isotherms were constructed by plotting for each temperature the equilibrium moisture-content values (dry basis), as ordinates against the corresponding values of equilibrium relative humidity on the abscissas. The curves were then drawn through the values corresponding to each temperature. In the absence of experimental data for relative humidities below 10 percent, the lowermost portions of the isotherms were constructed by extrapolating the curves to converge at the origin. To obtain the isotherms above 85 percent humidity, a method suggested by Bull(4) was used for extrapolating the curves up to the saturation pressure. Coleman and Fellows(5) reported 31.2 percent, dry basis, as the equilibrium moisture content of yellow dent shelled corn at 100 percent relative humidity and 77 F. This is in excellent agreement with the extrapolated values. By using this method, the shortcomings of the static method in securing data due to susceptibility of samples to molding were circumvented. Information available on equilibrium moisture content at high relative humidities are extremely meager.

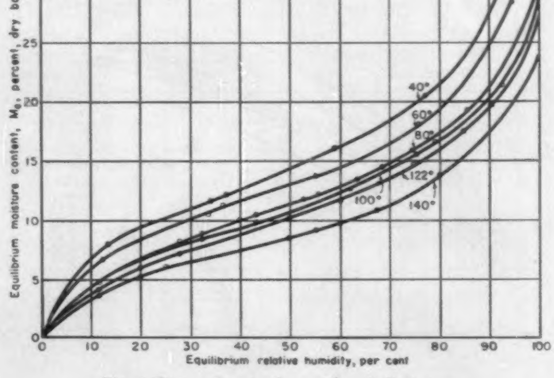


Fig. 2 Desorption isotherms for shelled corn

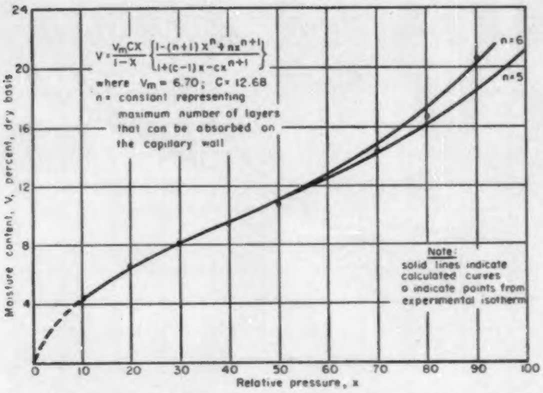
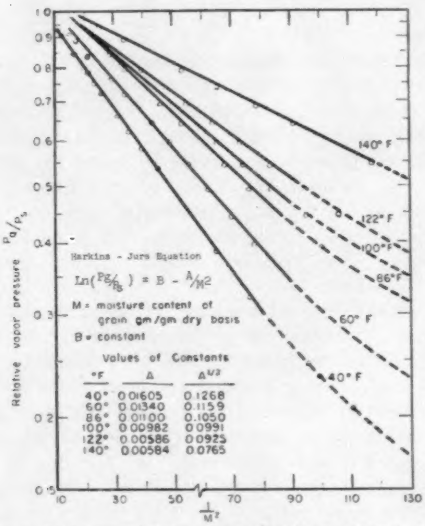
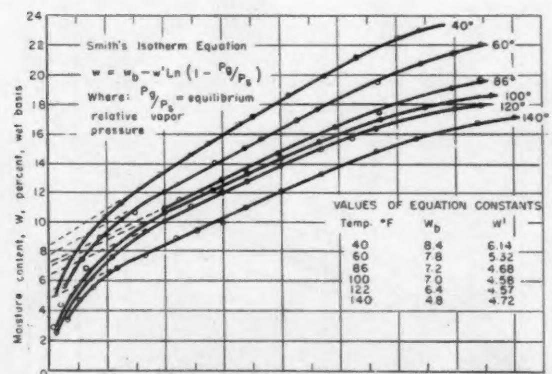


Fig. 3 Desorption isotherm for 100 F plotted according to B-E-T three-constant equation as compared with experimental points



°F	A	$A^{1/2}$
40°	0.01605	0.1268
60°	0.01340	0.1159
86°	0.01100	0.1050
100°	0.00982	0.0991
122°	0.00586	0.0925
140°	0.00584	0.0765

Fig. 4 H-J plots of desorption isotherms for shelled corn



VALUES OF EQUATION CONSTANTS

Temp. °F	w_b	w'
40	8.4	6.14
60	7.8	5.32
86	7.2	4.68
100	7.0	4.58
122	6.4	4.57
140	4.8	4.72

Fig. 5 Smith plots of desorption isotherms for shelled corn

. . . Equilibrium Moisture

The simple two-constant B-E-T equation explained the relative humidity-moisture content isotherms between 5 and 50 percent. In line with the original thesis of Brunauer, it can be concluded that the water-binding mechanism involved in shelled corn is one of multimolecular adsorption.

Beyond 50 percent relative humidity, the amount of water adsorbed increases more and more slowly than indicated by the equation. The two-constant equation was derived for adsorption on a free surface, and it is quite evident that the internal surface of grain is by no means a free surface. Within the range of relative pressures for which the equation holds, the influences which restrict the number of molecular layers have generally not yet become strong enough to make themselves noticeable. Beyond that range, however, it is necessary to use the three-constant equation which was derived to account for the situation where only a finite number of layers are absorbed at saturation pressure. While there may be other causes for such a restriction, the effect of the pores and capillaries which characterize the surface is probably the most important. The equation introduces one more constant denoted by n, which represents the maximum number of layers that can be adsorbed on each wall of the capillary. By a process of trial and error, using different values of the constant n, a curve was obtained that best fits the experimental points. Fig. 3 shows the results obtained with the value of $n=5$ and $n=6$ for 100 F isotherm. Up to a relative humidity of 70 percent, the value of $n=5$ gives almost a perfect fit with the experimental isotherm. At a relative humidity of 90 percent, the value of $n=6$ gives a reasonably good fit. Thus, with only two values of n, the equation can be used in reproducing the isotherm correctly up to a relative humidity as high as 90 percent.

The previous information can be interpreted to mean that the micropores characterizing the internal surface of shelled corn are comparatively uniform in size. The narrower pores fill up at the lower relative pressures while the wider pores fill up at the higher pressures. It can be seen that the maximum number of molecular layers which can be accommodated on each wall of the average-sized capillary was five up to a relative humidity of 70 percent and six up to a relative humidity of 90 percent. Assuming a diameter for the water molecule of 2.9 angstroms, it can be calculated that the average width of the micropores participating in adsorption up to a relative humidity of 90 percent is of the order of 32 angstroms. Furthermore, by taking the value of constant V_m of the B-E-T equation as 7.1 grams per 100 grams of dry grain obtained for the 86 F isotherm, and assuming that a water molecule occupies an area of 11.0 square angstroms, it was calculated that a surface area of 6.5 acres was available for moisture adsorption per 100 grams of dry grain.

Excellent correlation between the experimental and theoretical calculations based on the Harkins-Jura equation was obtained for moisture contents down to 10 percent, dry basis, and for relative humidities from 40 to 45 percent (Fig. 4). According to the theory, these results indicate that in these ranges the adsorbed water occurs as a condensed film.

When using Smith's equation, which is normally applicable for relative humidities above 50 percent (Fig. 5), it can be noted that the plots have good straight lines extending between the logarithmic values on the abscissa of about

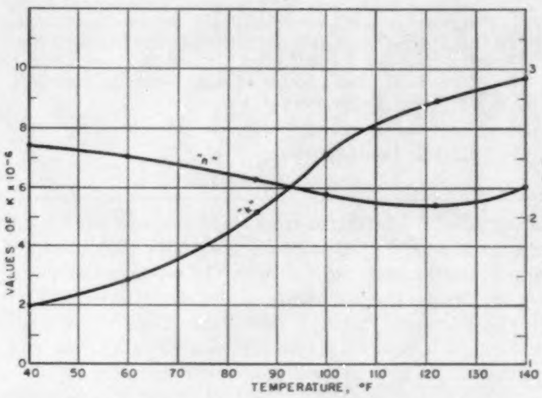


Fig. 6 Temperature dependence of constants K and n of Henderson's equation

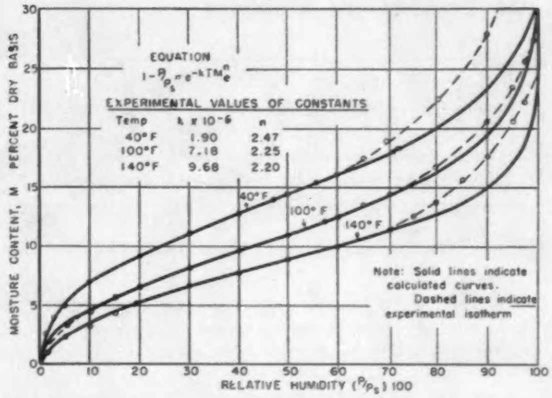


Fig. 7 Curves plotted according to Henderson's equation compared with desorption isotherms

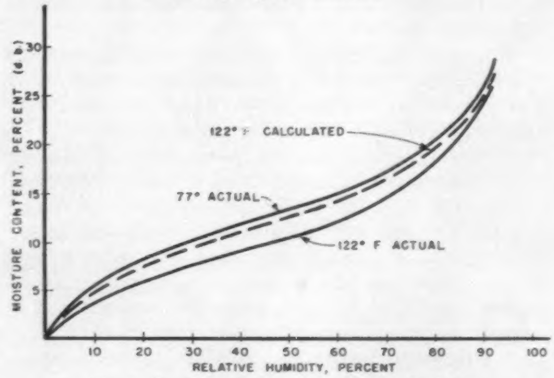


Fig. 8 Equilibrium moisture content of wheat

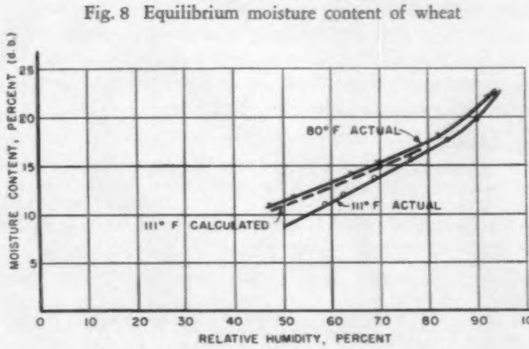


Fig. 9 Equilibrium moisture content of rice

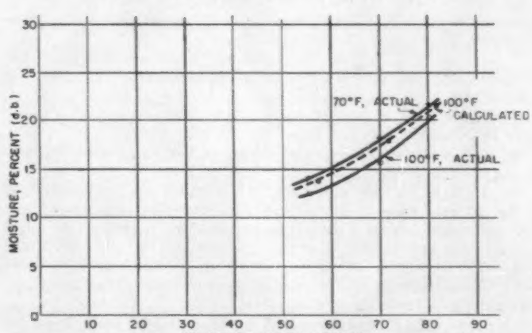


Fig. 10 Equilibrium moisture content of pea beans

0.6 and 2.0 which correspond to a range of relative humidities from 45 to 90 percent.

The constants were calculated for each of the isotherm equations discussed previously. In every case the constants varied with a change in temperature and it cannot be assumed that the same constants will apply at the different temperatures.

If Henderson's equation accounts correctly for the temperature dependence of the isotherm, one should be able to calculate the curve at any temperature on the basis of values previously determined for the constants k and n. The experimental data were evaluated to obtain the equation constants as shown in Fig. 6. The values of k and n show a definite dependence on temperature. Thus it would be necessary to state k and n values for the various temperatures involved. To evaluate the reliability of the shape of the isotherm, experimental and theoretical values of the moisture content show that there was excellent agreement from 20 to 60 percent relative humidity. Beyond that range the experimental isotherms generally deviate markedly in an upward direction from the calculated curve, for the higher relative humidity (Fig. 7).

Further evaluation of Henderson's equilibrium equation was made for wheat, rice, pea beans and sugar beet seeds from data available at different temperatures for these products (1, 12, 7, 9). In all cases the actual equilibrium moisture contents at a given relative humidity and temperature were below the theoretical or calculated moisture content determined on the basis of the data obtained at the lower temperature (Figs. 8, 9, 10, 11).

Conclusions

1 The desorption isotherms were characteristic B-E-T type II, S-shaped or sigmoid isotherms.

2 The equilibrium moisture data of shelled corn yielded satisfactory plots in the range from 5 to 35 percent moisture with the B-E-T (type II), two-constant equation. Using the B-E-T equation and comparing with data by other investigators showed that multimolecular adsorption is probably the predominant water-binding mechanism in shelled corn.

3 When examined by Smith's equation, the equilibrium moisture content of shelled corn was found to yield good relationships from 45 to 90 percent humidity.

. . . Equilibrium Moisture

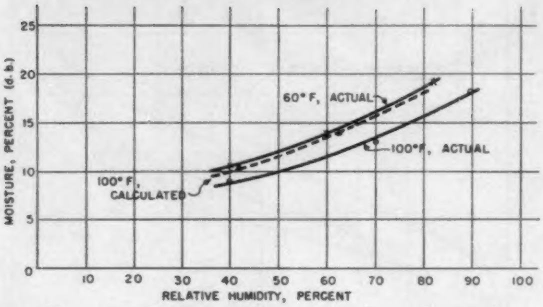


Fig. 11 Equilibrium moisture content of sugar beet seed

4 A graphic method recently proposed by Becker and Sallans for determining the intermediate linear region of the isotherm was found to result in excellent agreement with experimental data.

5 Treatment of the data by means of the Harkins-Jura equation yielded excellent relationships in the range of 45 to 90 percent relative humidity which illustrates that in this region adsorbed water occurs as a condensed film.

6 When the isotherm data were examined with the B-E-T, three-constant equation, the applicability of the equation was from 70 to 90 percent relative humidity depending upon the *n* value used. These results suggest that despite its heterogeneous character, shelled corn possesses a fairly uniform porous structure involving micropores of an average width in the order of 30 angstroms requiring from 5 to 6 molecular layers of water to become completely filled.

7 Henderson's equation successfully describes the shape of the isotherm in the range of relative humidities from 10 to 60 percent and understates the moisture content values above that range. The equation fails to account correctly for the temperature dependence of the isotherms for corn, wheat, rice, pea beans, and sugar beet seeds.

References

1 Becker, H. A. and Sallans, H. R. A study of internal moisture movement in the drying of the wheat kernel, *Cereal Chem.* 32: 212-226, 1955.

2 Brunauer, S. The adsorption of gases and vapors. Vol. I, Princeton University Press, Princeton, 1945, 511 pp.

3 Brunauer, S., Emmett, P. H. and Teller, E. Adsorption of gases in multimolecular layers, *J. Am. Chem. Soc.* 72: 2102-2105, 1950.

4 Bull, H. Adsorption of water vapor by proteins, *J. Am. Chem. Soc.* 66: 1499-1507, 1944.

5 Coleman, D. A. and Fellows, H. C. Hygroscopic moisture in cereal grains, *Cereal Chem.* 2: 275-287, 1925.

6 de Boer, J. H. The dynamical character of adsorption. The Clarendon Press, Oxford, 1953, 239 pp.

7 Dexter, S. T., *et. al.* Responses of white pea beans to various humidities and temperatures of storage, *Agron. J.* 47: 246-250, June, 1950.

8 Dunford, H. B. and Morrison, J. L. The adsorption of water vapor by proteins, *Can. J. Chem.* 32: 558-564, 1954.

9 Hall, Carl W. Storage and drying of beet sugar seeds, *J. Am. Soc. Sugar Beet Tech.*, 1956.

10 Harkins, W. D. and Jura, G. A water adsorption method for the determination of the area of a solid without the assumption of a molecular area, and the air as occupied by nitrogen and other molecules on the surface of a solid, *J. Am. Chem. Soc.* 66: 1366, 1944.

11 Henderson, S. M. A basic concept of equilibrium moisture, Agricultural Engineering, 33: 29-32, 1952.

12 Hogan, J. T. and Karon, M. L. Hygroscopic equilibrium of rough rice at elevated temperatures, (Mimeo., 15 numbered pages) 1955.

13 Rodriguez-Arias, Jorge H. Desorption isotherms and drying rates of shelled corn in the temperature range of 40 to 140 F, thesis for Ph.D., department of agricultural engineering, Michigan State University, 1956.

14 Smith, S. E. The sorption of water vapor by high polymers, *J. Am. Chem. Soc.* 69:646-651, 1947.

. . . Land Leveling

(Continued from page 465)

In our case, a 0.1 percent cross slope was selected for the first plane, a level cross slope for the middle plane, and 0.3 percent for the plane on the right. To simplify and facilitate the design, the boundaries of the planes should always be placed midway between grid lines. This is true especially where a field drain may fall between planes; the grid stakes then can serve as check points for construction.

Use of Profiles to Determine Row Slope

The length of plane was tentatively decided earlier in order to total up stake rows in the vertical direction. This decision was then affirmed. The next step was to total rod readings horizontally across each individual plane. These readings were plotted as a profile along the side of the sheet to give a good indication of the most economical slope to be used in the direction of flow (Fig. 4). This is the method generally used to determine proposed design slopes. It is thought to be faster than the method of "least squares" or plane-of-best-fit. Since it is necessary to add up all the rod readings anyway in order to use the plane method, it requires very little time to make an average profile. Also, the least squares method generally on the flat topography of the Missouri bottom gives a slope that is not steep enough to provide adequate surface drainage.

After the desired slopes were computed, the remainder of the design was made using the plane method. The shrinkage factor used varied from 0.05 to 0.15 ft for this bottomland area. Usually the fields have been leveled very soon after some type of tillage operation, and the soil is loose. This raises the shrinkage factor and causes the cut-fill ratio to go up.

Summary

Irrigation has moved rapidly into the Missouri bottoms of Iowa the last few years. Many landowners have leveled their land to provide for both surface drainage and surface irrigation with the same system. A majority of the soils on this floodplain are fine textured and need surface drainage more than anything else. The last few years have been dry, and this has given the added impetus to many to go ahead and install these combined systems. The results to date are gratifying; yields of corn on two farms under irrigation have been measured at 135 bu per acre. Farmers figure this type of system as a double insurance — against the hazards of either a wet or dry year. The systems will be used in the spring for drainage, and in July and August for irrigation. It is the general belief of most farmers that they will be irrigating in nine out of ten years now that they are set up for it.

References

Wood, Ivan D. Land preparation for irrigation and drainage, Agricultural Engineering, November, 1951.

Givan, C. V. Land grading calculations, Agricultural Engineering, January, 1940.

Chugg, G. E. Calculations for land grading, Agricultural Engineering, October, 1947.

Fan Ventilation Control for Poultry Houses

W. L. Roller
Assoc. Member ASAE

A. C. Dale
Member ASAE

Agricultural engineers develop temperature-modulated, time-cycle control system that produces results superior to natural ventilation

THE lack of a satisfactory control has been one of the main problems in fan ventilation of poultry houses and other animal shelters. Present controllers are either unsatisfactory because they will not withstand the dust-laden, corrosive atmosphere of such buildings, or they do not provide correct air flow for the varying outside weather conditions.

Research was begun at Purdue University in 1953 with the purpose of developing a more effective and reliable controller for fan ventilating systems. A review of the existing controllers showed four types to be in common usage but none without fault. Humidistats do not function satisfactorily in dusty atmospheres, and, if used, they must be accompanied by a thermostat to limit the inside temperature drop. Thermostats will control the fans fairly well at moderately high temperatures but their effectiveness is curtailed at temperatures below their setting. The interval-time controller is satisfactory only when the operating time is adjusted to the outside air conditions; also, it does not provide for a decrease in air flow when a severe temperature drop occurs.

Automatically controlled louvers vary the output of fans effectively when they work properly; however, they achieve a reduction in ventilation by a process that may increase energy consumption of the fan. In addition, they are subject to sticking in the wrong position due to corrosion or formation of ice.

As a result of their review, it was evident to the authors that many of the above-mentioned faults could be eliminated by a controller which had the combined characteristics of an interval-time cycle and thermostatic controller. A similar controller was developed by J. G. Taylor (1)* for use with infrared brooders. The components of this controller were a snap-action switch, a liquid-filled temperature-sensitive bellows unit, a cam, and a cam-drive motor. These components were arranged in such a manner that the brooder lamps were turned on and off once each revolution of the cam. The temperature actuated bellows moved the micro-switch trigger more closely or less closely to the cam resulting in a change in the operating time of the lamps during each cycle corresponding to the temperature change.

Development of the Controller

Using this operating principle, a temperature-modulated, time-cycle controller, as shown in Figs. 1 and 2, was developed for use with fans in a laying house. As the temperature changes, the bellows plunger changes the elevation of the snap-action switch through the lever arm. As the elevation of the snap-action switch is changed, the "on" time of the switch during each cycle is changed. As the temperature rises, the "on" time is increased, and as the temperature decreases, the "on" time is decreased. Adjustments may be made by the screw at the bottom of the bellows.

Use of Outside Temperature for Control

Outside temperature was used as the stimulus for control because *(a)* the controller may be placed out of the dusty, corrosive atmosphere of the poultry house, *(b)* it senses any sudden change in the outside temperature thus preventing an abrupt change in the temperature within the house, and *(c)* a greater range of temperature is available for actuating the bellows. Once the flock size, building construction, fan size and running time are fixed, the inside temperature becomes a direct function of the outside temperature. However, the fan system and controller must be adjusted to fit each particular flock and building.

The Test Houses

A well-insulated, 30 x 100-ft monolithic concrete laying house on the Purdue poultry farm was used to test the controller for its functioning. The over-all conductance coefficient of the house was 0.15 Btu/(ft^2)(hr)(deg F) with an exposure ratio such that the total heat loss was 700 Btu/(deg F)(hr). At the time of the test, 800 hens of a heavy breed were housed in the building.

The control building was of identical construction and orientation but housed 1,000 hens of a light breed. Ventilation of the control house was accomplished by the frequent changing of window openings along the south side during working hours. The window settings were unchanged throughout the night.

Determination of Air Flow Requirements

In the calculations of the heat and moisture balances, the value of heat and moisture production published by Ota, Garver, and Ashby (2) were used. These values were applied to other weight chickens by assuming that the heat production is proportional to the 0.73 power of the live weight as published by Kliebar (3) and Brody (4). The total heat content from the Carrier psychometric chart was

Preliminary paper presented at the annual meeting of the American Society of Agricultural Engineers at East Lansing, Mich., June 1957, on a program arranged by the Farm Structures Division and based on research work performed under Project 631, "Mechanical Ventilation of Poultry Houses," at the Purdue University Agricultural Experiment Station (approved as Journal Paper No. 934).

The authors — W. L. Roller and A. C. Dale — are, respectively, formerly junior assistant in agricultural engineering (now instructor at Ohio State University) and professor of agricultural engineering, Purdue University.

Acknowledgement: The authors express appreciation to John G. Taylor, deceased, for advice and assistance; to Roy E. Roberts and other members of the poultry science department for furnishing birds, housing and observations in connection with the study, and to the Indiana Farm Electrification Council for financial support of the project reported in this paper.

*Numbers in parentheses refer to the appended references.

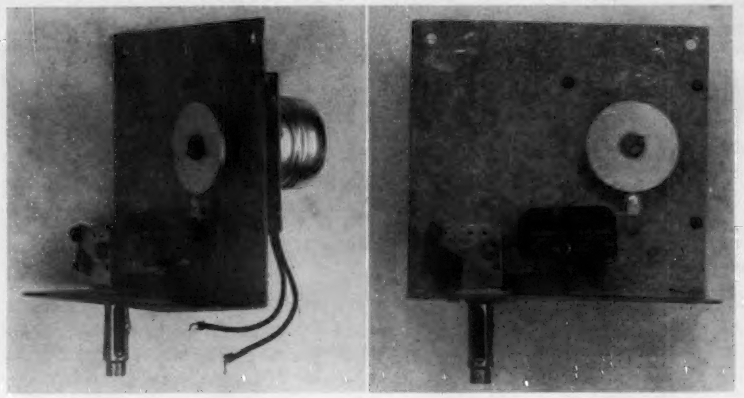
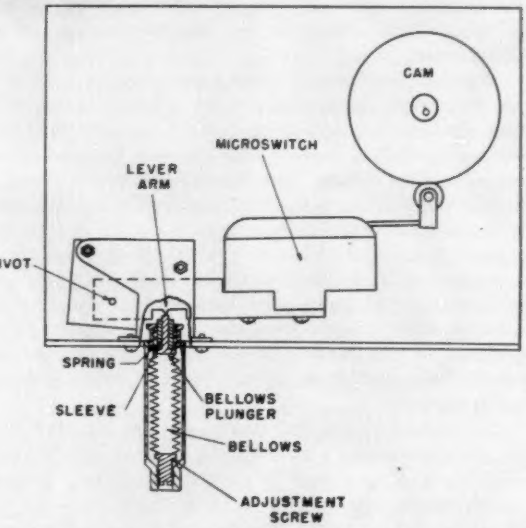


Fig. 1 (Left) Two views of the temperature-modulated, time-cycle controller developed to control poultry-house ventilation

Fig. 2 (Below) Operating elements of the temperature-modulated, time-cycle fan controller



used in calculating the heat and moisture lost to the ventilating air. It was considered that the *total* heat production of the birds was available for changing the heat content of the ventilating air.

The following assumptions were made in the calculation of air flow rates:

Outside relative humidity — 75 percent (5)
Inside relative humidity — 75 percent
Outside mean temperature — 27 percent (5)
Outside temperature range — 68 to —15 F
Inside temperature — Above freezing at the mean outside temperature and above 20 F at all times

Air flow rates, that would remove the most moisture for the least heat loss, were established by applying the heat and moisture balance equations for each 5 deg increment of outside temperature. The curves of the calculated air flow rate and inside temperature versus outside temperature are shown in Fig. 3.

Two exhaust fans with a capacity of 4300 and 1860 cfm, respectively, were installed in the north wall of the test house to provide the ventilation. Two fans provide a more flexible system than would one, and at low temperatures (18 F and lower) the air change with only the low-capacity fan on is not so rapid as to lower the temperature too much in the house.

Construction

Two temperature-modulated, time-cycle controllers were constructed. The cam on the small controller was cut to cause the small fan to cycle and provide the needed air flow between —15 and 18 F. Above 18 F the small fan ran continuously. The cam on the large fan controller was cut to cause the large fan to provide supplemental ventilation from "full off" at 18 F to "full on" at 68 F.

A cam drive motor, turning one revolution per minute, was initially used on both controllers. During the trial runs, the small fan motor operated satisfactorily on this cycle. However, the large fan motor overheated on a one-minute cycle and it was changed to operate on a four-minute cycle. On this cycle it operated without trouble.

The Experimental Runs

The temperature-modulated, time-cycle control system was operated during two test periods, one from March, 1954, until August, 1954, and the second intermittently from November 8, 1954, until February 7, 1955. The temperature and relative humidity in both houses and outside were recorded. Operating times of the fans were recorded on an Esterline-Angus operation recorder.

Results

The temperature-modulated, time-cycle controller made more efficient use of the available heat in removing moisture from the building than the natural ventilation system. There was a highly significant difference between the relative humidities in the two poultry houses. The average relative humidity in the test house was 4.0 to 5.2 percent lower than the relative humidity in the control house. At the same time, the temperatures in the two houses were not significantly different.

During the time the temperature-modulated, time-cycle controller was in operation, the air in the test house seemed fresher. Less frost accumulated on the walls and the flock attendant was well satisfied with the performance of the system.

In operation, the control usually worked with an accuracy of ± 2 deg of the outside temperature. Inaccuracies were caused by many small factors, including improper adjustments. In general, the accuracy of the controller was directly dependent upon the accuracy with which the cam was cut.

The actual operation of the controller produced nearly a linear variation of running time with temperature rather than

a characteristic curve similar to the curve of the desired air flow rates (Fig. 3). Since the resulting ventilation was apparently good, this does not appear to be critical. The average inside temperatures experienced during the intermittent test runs between November 1954 and February 1955, are shown in Fig. 4. This curve is compared to the calculated inside temperature curve in Fig. 3. The inside temperature averaged about 8 deg warmer than anticipated. This was apparently due to the heat gained from solar radiation and litter decomposition which was not considered in calculating the inside temperature curve. A recheck of the heat and moisture-balance equations showed there was approximately 35,000 btu per hr added from these and unknown sources. Thus there was almost 65 percent more heat available than was anticipated. This was due to neglecting solar radiation and litter decomposition.

The dependability of the system was excellent as only minor mechanical difficulties were encountered. Also, the ability of the systems to correct the ventilation rate automatically to conform with sudden weather changes added much to the peace of mind of the flock attendant.

The energy required for the system is a function of the temperature and varied in the tests from 6.3 kw-hr per day at 25 F to 10.6 kw-hr per day at 47 F.

The temperature-modulated, time-cycle controller could be easily manufactured. If the cam is cut to give a straight-line relation between fan running time and temperature, the controller could be produced for about twice the price of a thermostat and could be adaptable to a range of flock sizes, building construction, fan sizes and perhaps animal species by adjusting the screw under the bellows.

Conclusions

1 Outside temperature is an effective and satisfactory stimulus for the control of ventilation in a laying house.

2 The temperature-modulated, time-cycle principle of control is workable when the length of cycle is kept above the minimum recycle time of a standard electric motor.

3 The construction of the controller is simple.

4 The ventilation provided by the temperature-modulated, time-cycle control system was superior to natural (gravity and wind) ventilation. The air was about the same temperature in both cases but the humidity was significantly less with the fan system. Drafts were less troublesome, the ammonia odor was not so strong, condensation was not so prevalent, and the birds were healthier with this system.

5 The cost of the temperature-modulated, time-cycle-controlled ventilation system was less than the cost of paying the flock caretaker for his time to adjust the windows in the natural ventilation system. The cost of this system is estimated to be 5 percent higher than the cost of the same system with conventional thermostats. Since one controller could handle more than one fan in a large installation, this percentage would go down as the cost of the entire system was increased.

6 The major fault of the temperature-modulated, time-cycle control system is the care and calculations necessary to fit it to the building, flock, and fans.

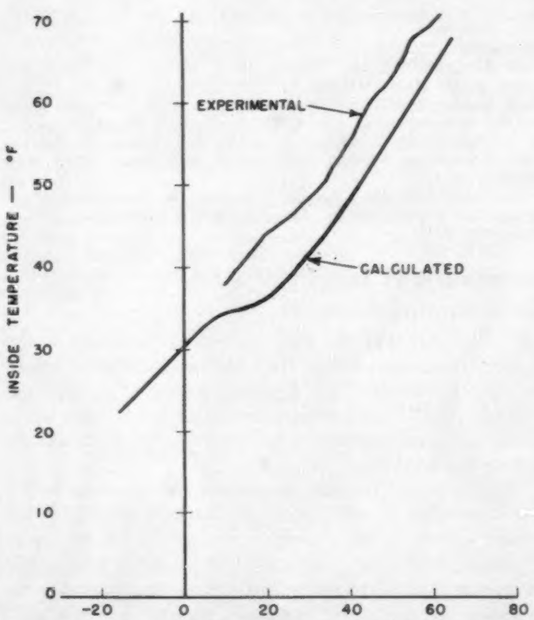


Fig. 3 Calculated air flow rate and inside temperature vs. outside temperature

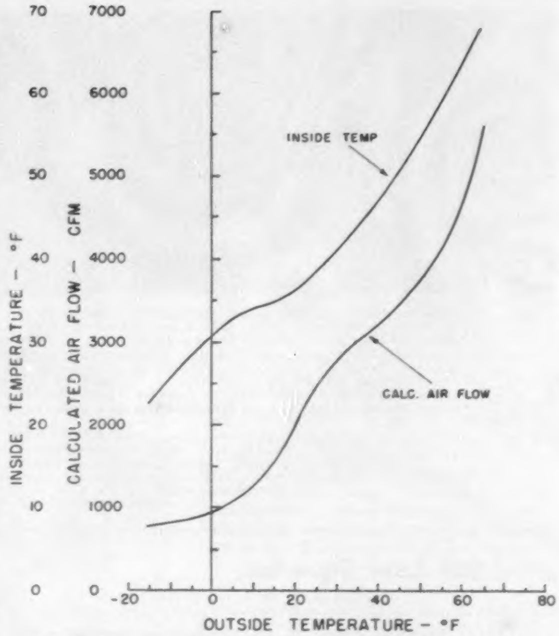


Fig. 4 Actual operating temperatures in the poultry house as contrasted to the computed temperatures

References

1 Taylor, John G. Proportional-time infrared-lamp controller for brooders. USDA Agricultural Research Service Publication 42, May 1955.

2 Ota, Hajime, Garver, H. L., and Ashby, Wallace. Heat and moisture production of laying hens. AGRICULTURAL ENGINEERING 34:163-167. March 1953.

3 Kliebar, Max. *Hilgardia*, University of California. Berkeley, Calif., Vol. 6, January 1932.

4 Brody, S. *Bioenergetics and Growth*, Rheinhold Publishing Corp., New York, 1945.

5 Kincer, J. B. Climate and weather data for the United States. Climate and Man, Yearbook of Agriculture, Washington, D.C., 1941.

Take Hawaiian Tour

★

Blue Ribbon Winner

(Above) ASAE members and wives, who concluded the 51st Annual Meeting in Santa Barbara, Calif., with a post-convention tour to Hawaii, are shown as they were about to board a plane at Los Angeles for Honolulu. From left, Mr. and Mrs. R. K. Derry, Canton, Ohio; Mr. and Mrs. H. W. Simpson, Dearborn, Mich.; Mr. and Mrs. F. R. Jones, A & M College of Texas, College Station; Mr. and Mrs. W. W. Henning, Chicago, Ill.; and Mr. and Mrs. G. S. Messinger, Tatamy, Pa. Side tours to the Hawaiian Sugar Planters Assn. and the Pineapple Research Institute were available

(Right) Presentation of a blue ribbon was made to J. D. Netherton *(left)* before a headquarters staff of approximately 125 members, by D. S. Weaver, director, North Carolina Agricultural Extension Service. Mr. Netherton was a blue ribbon winner in the extension exhibits awards in the methods outlines entry at the 51st Annual meeting of ASAE at Santa Barbara, Calif.

. . . Soil-Loss Equation

(Continued from page 462)

3 Gunn, Ross and Kinzer, G. D. The terminal velocity of fall for water droplets. Journ. Met. 6: 243-248 (1949).

4 Laws, J. O. Measurements of fall velocities of water drops and raindrops. Trans. Amer. Geophys. Union 22: 709-721 (1941).

5 Laws, J. O. and Parson, D. A. The relation of raindrop size to intensity. Trans. Amer. Geophys. Union 24: Part II, 452-459 (1943).

6 Lloyd, C. H. and Eley, G. W. Graphical solution of probable soil loss formula for the northeastern region. Jour. Soil Water Conserv. 7(4): 189-191 (Sept. 1952).

7 Musgrave, G. W. The quantitative evaluation of factors in water erosion—a first approximation. Jour. Soil Water Conserv. 2: 133-138 (1947).

8 Smith, D. D. and Whitt, D. M. Evaluating soil losses from field areas. Agricultural Engineering, 29: 394-396 (1948).

9 Smith, D. D., Whitt, D. M. and Miller, M. F. Cropping systems for soil conservation. Mo. Agr. Exp. Sta. Bul. 518 (1948).

10 Smith, D. D., and Wischmeier, W. H. Mechanics of sheet erosion. Trans. Amer. Geophys. Union. (In Press).

11 U.S. Dept. Agr., Soil Conservation Service. Ready references for conservation farm planners, Milwaukee, Wisc. Revised (1956).

12 Van Doren, C. A., and Bartelli, J. J. A method of forecasting soil loss. Agricultural Engineering, 37(5): 335-341 (May 1946).

13 Wischmeier, W. H. Punched cards record runoff and soil-loss data. Agricultural Engineering, 36(10): 664-666 (Oct. 1955).

14 Wischmeier, W. H., and Smith, D. D. Rainfall energy and its relationship to soil loss. Trans. Amer. Geophys. Union. (In press).

15 Zingg, A. W. Degree and length of land slope as it affects soil loss in runoff. Agricultural Engineering 21(2): 59-64 (Feb. 1940).

. . . Paddle Tip-Clearance

(Continued from page 457)

at 800 rpm. It seems reasonable that, with hay coming into the blower at the same rate, there would be more interference at the cutoff point at the lower speed.

Though capacity tests were not of a conclusive nature and are not reported here, a feed rate of 30 tons per hour was handled with no difficulty by a ⅜-in. clearance at a speed of 850 rpm. It is felt that, with the type of material handled, capacity is definitely not a limiting factor in the use of larger tip-clearances.

The fact that the pipe height was constant at a relatively low level unfortunately does not allow a definite statement as to the elevating ability of the larger tip-clearances. However, no difficulty was encountered in delivery to approximately 30 ft at speeds as low as 750 rpm. No tests were run without the 180-deg deflector on the pipe.

From this study it appears that the effect of paddle tip-clearance on the forage-blower power requirement is to a large degree confounded with the poor paddle unloading characteristics which result in cutoff-point interference. Given ideal unloading, a relationship of tip-clearance to power requirement entirely different than the one shown here may well result. There appears to be a definite need for a fresh and fundamental approach to housing, impeller and paddle configuration and to placement of incoming material.

References

1 Blevins, F. Z. and Hansen, H. J. Analysis of forage harvester design. Agricultural Engineering 37:21-26, 29. 1956.

2 Duffee, F. W. A study of factors involved in ensilage cutter design. Agricultural Engineering, 7:84-87, 98. 1926.

3 McLeod, H. E. Effects of paddle tip-clearance on performance of a forage blower. Unpublished M.S. thesis, Iowa State College. 1957.

4 Raney, J. P. and Liljedahl, J. B. Impeller blade shape affects forage blower performance. Agricultural Engineering 38:722-725. 1957.

Nominations for 1959 ASAE Gold Medal Awards

IN ACCORD with the rules governing the award of the John Deere and Cyrus Hall McCormick Gold Medals, the Jury of Awards of the American Society of Agricultural Engineers will receive from members of the Society, up to November 1, nominations of candidates for the 1959 awards of these two medals.

The Jury will consider nominations received on or before November 1, and these nominations should be addressed directly to the Executive Secretary of the Society at St. Joseph, Michigan. The Executive Secretary will supply on request a standard set of instructions for preparing information in support of nominees for the Society's gold medal awards; in fact, it is important that these instructions be followed in preparing material on behalf of any nominee.

Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. Information concerning copies of these papers may be obtained by writing to the American Society of Agricultural Engineers, St. Joseph, Mich.

Underseepage Control for Levees, by Henry A. Sikso, chief, foundations and materials branch, U. S. Army Engineer District, Omaha, Nebr. Presented at the Winter Meeting of the ASAE in Chicago, Ill., December, 1957, on a program arranged by the Soil and Water Division. Paper No. **57-544.**

The problem of underseepage control is one of the most serious problems in the design of levees. Underseepage is defined and conditions conducive to underseepage are explained. Several satisfactory methods of control are discussed, such as, riverside impervious blanket, relief wells in drainage ditch and landside berms. Each method has its advantages and disadvantages. Any of these methods are feasible and their application depends on the depth of pervious strata, economics of construction, availability of right-of-way and the degree of underseepage protection considered necessary.

Irrigation-Mosquito Problems in the United States, by Committee on Irrigation System Design for Mosquito Control. Copies available by writing the American Society of Agricultural Engineers, 420 Main Street, St. Joseph, Mich. Paper No. **58-49.**

This paper reports on mosquito problems occurring in many irrigated areas, particularly those in the Western states, and where sources of mosquitoes are generally a by-product of the same faulty irrigation and drainage practices that create serious agricultural problems.

The committee brings out the fact that the ultimate solution to mosquito problems associated with irrigation must be based upon source reduction measures that are aimed at preventing, eliminating or reducing man-made mosquito producing areas. This, they believe, can be accomplished by the use of good irrigation and drainage practices including adequate measures for preventing and controlling canal seepage; proper land preparation, field layouts and irrigation methods that fit land, crops and water supply; application of water according to crop requirements; adequate drainage systems for removal and disposal of excess water; and proper maintenance of distribution and drainage systems. The report contains a section on the biology of irrigation mosquitoes, relation of irrigation to mosquito production, the prevention and elimination of mosquito sources associated with irrigation, and photographs of typical mosquito sources associated with irrigation.

Various Shade Materials, by C. F. Kelly and T. E. Bond, respectively, professor of agricultural engineering, University of California, and agricultural engineer, Livestock Engineering and Farm Structures Research Branch, ARS, USDA. Paper presented at the Annual Meeting of ASAE, Santa Barbara, Calif., June 1958, on a program arranged by the Farm Structures Division. Paper No. **58-204.**

Cooperative studies by the University of California and the U.S. Department of Agriculture at Davis and El Centro, Calif., have shown the value of shades for improving weight gains of beef cattle, and led to the development of a method for the geometrical design of shades to obtain the optimum results with a given material. This paper compares 35 different materials or treatments which are used for shades as to their "effectiveness." "Effectiveness" is taken as being the reduction in radiant heat load under the sample material divided by the reduction under new corrugated aluminum, which was considered the "standard." The measurements of radiant heat load were made with globe thermometers located at the center of the shadows under 8 ft x 12 ft shades 4 ft high.

Application of Continuous Mechanics to Soil Compaction, by G. E. Vanden Berg, W. F. Buchele, and L. E. Malvern, respectively, graduate research assistant in agricultural engineering, associate professor of agricultural engineering, and associate professor of applied mechanics, Michigan State University, East Lansing, Mich. Paper presented at the Annual Meeting of ASAE at Santa Barbara, Calif., June 1958, on a program arranged by the Power and Machinery Division. Paper No. **58-54.**

This paper considers the soil as a continuous medium which thus provides a mathematical model to describe the soil. The concepts involved in the mechanics of a continuous medium are reviewed and their application to soil are discussed. It is suggested that a simplification in studying soil compaction can be made by ignoring the shearing deformations and rotations. This is possible, the authors state, since change in compaction is the volume strain of the soil. At any point the volume strain can be expressed independently of any shearing strains that may have taken place. The hypothesis that mean normal stress controls volume change of the soil is proposed. It is shown how existing equipment can be used to measure the forces acting on a volume element of the soil and thereby test the above hypothesis or any other hypothesis that may be proposed.

Construction and Evaluation of Performance of a Horizontal Well in a Shallow, Thin Aquifer, by E. J. Doering, agricultural engineer, U.S. Salinity Laboratory, Riverside, Calif. Paper presented at the Annual Meeting of ASAE in Santa Barbara, Calif., June 1958, on a program arranged by the Soil and Water Division. Paper No. **58-167.**

The construction of large diameter vertical wells to secure large yields of water from ground-water sources often is not a practical consideration because yield is not proportional to well diameter. The author states that the horizontal well is a possible solution of such a problem especially when the aquifer is both shallow and thin.

This paper describes an experiment which involved an aquifer that had a saturated thickness of 7 ft and was covered with approximately 11.5 ft of overburden of which all except the top 16 in. (approximately) was sand and gravel. The horizontal test well consisted of 77 ft of 8-in. diam, 14-gage, perforated well casing placed horizontally with an 18-in. diam, and a 14-gage riser at each end forming the letter "U". The well was assembled and placed as a unit in a pit that was constructed from the ground surface to the bottom of the aquifer with a dragline. Test results are given.

Reclamation of Salt-Affected Soils, by Ronald C. Reeve, agricultural engineer, U.S. Salinity Laboratory and Western Soil and Water Management Research Branch, Riverside, Calif. Paper presented at the Annual Meeting of ASAE in Santa Barbara, Calif., June 1958, on a program arranged by the Soil and Water Division. Paper No. **PL58-7.**

The reclamation of salt-affected soils involving the removal of excess salts or exchangeable sodium, and the restoration of favorable soil physical conditions are discussed in this paper. The only method known whereby excess salts or exchangeable sodium can be effectively removed from the root zone of saline or sodic soils involves leaching by the passage of water through the soil.

Saline soils contain excess soluble salts and are reclaimed by leaching without amendments. In the case of sodic soils which contain excess exchangeable sodium, soluble calcium must be present in the soil solution to replace the exchangeable sodium as the soil is leached. The soluble calcium may come from the soil in which gypsum or calcium carbonate is present, from the irrigation water, or may be supplied by amendments such as gypsum and calcium chloride applied directly to the soil or added in the leaching water. The acids or acid-forming amendments, such as sulfuric acid and sulfur, make calcium available only if calcium carbonate is present in the soil.

The quantity of water required for leaching and the amounts of amendments required for replacement of exchangeable sodium are discussed.

The California Water Plan, by William L. Berry, chief, Division of Resources Planning, California Department of Water Resources. Paper presented at the Annual Meeting of ASAE in Santa Barbara, Calif., June 1958, on a program arranged by the Soil and Water Division. Paper No. **58-150.**

This paper discusses the continuing critical problems of water in California which led, in 1947, to legislative authorization for a comprehensive investigation of the water resources of the state. The ensuing investigation, which was conducted by the Department of Water Resources and its predecessor agency, is described in general terms, together with certain of the results and conclusions of the studies.

The investigation, a 10-year endeavor, culminated in the publication of "The California Water Plan," a master pattern for future water resources development.

A portion of the paper is devoted to discussion of the California Water Development Program which comprises the detailed engineering, economic, and financial investigations and analyses required to determine the need and feasibility of specific individual projects included in the plan. The structures, costs, and accomplishments of the plan are given in tabular form.

The 1958 ASAE

THOMAS CARROLL

Cyrus Hall McCormick Medals were awarded to Thomas Carroll and Dent Parrett

DENT PARRETT

TOM CARROLL earned his laurels by devotion to engineering progress in the field of interest for which Cyrus Hall McCormick became most noted. In the measure of human values, theirs are major contributions to progress in providing man's "staff of life." In farm and trade language of equipment and operations, they were responsible for a series of advances in the harvesting end of farm mechanization. In the definitive terms of engineering, they applied physical science and related arts to improve the time, energy, motion and product economy of a major productive function—small grain harvesting.

In the test of practical application, Carroll's improvements in grain binders, combines, headers, and strippers have improved the harvest of untold billions of bushels of small grain in the major bread and feed grain regions of the world.

Tireless energy, unquestioning dedication, perfectionism—all characterize Thomas Carroll's globe-trotting career that saw his visionary ideas revolutionize harvesting implement design.

This Cyrus Hall McCormick Award winner seems never to know fatigue. Tom Carroll's workday on his frequent field trips to the harvest fields of the world may begin at dawn, end 14 or 15 hours later. Perhaps today it is to be a 100-mile drive over the bumpy dirt roads of the Argentine wheat belt. Then, in temperatures topping 100 F, 12 to 15 hours work in the harvest field on experimental machines. The only break—a lunch time siesta in the shade of the machines. After dark, back over the rough roads to the hotel—and up again at dawn the next morning.

But underneath the facade of the restless, disciplined, self-taught man is a compassionate human being who makes friends wherever he goes. Once he modified his combine design just to accommodate the "bota" of the Argentine farm hands. On a field trip Carroll noticed that the farm workers carried goatskin flasks—called botas —for wine or water. But the men had no place to put their botas while they worked. Carroll promptly specified a hook to be included under the bagging platform. Here the botas could hang safely away from the hot Argentine sun.

Carroll's career began in 1904 when he worked for the Buckeye Harvester Company in Melbourne, Australia. Two years later he took an extra job working nights at a Melbourne machine shop. The shop owner, a trained engineer, encouraged the 18-year-old's passion for machines, teaching him some engineering basics.

Born in 1888 on a farm in the sheep and cattle district of Gisborne, Australia, Carroll had only eight years' formal schooling in a country school. Nevertheless, he was able to grasp principles of engineering so well that he passed various correspondence courses in engineering.

His interest in stripper-harvester machines germinated in 1909 when he began working in field sales and service for J. J. Mitchell and Company of Melbourne.

In 1911, Carroll made the first of many intercontinental jaunts—a move to Buenos Aires, Argentina. Moore and Tudor, distributors of Massey-Harris farm equipment, selected young Tom Carroll to help introduce a new horse-drawn, ground-driven reaper and thresher in Argentina. The first models did not operate as expected and Tom drew from his earlier experience to play an important part in remodeling these machines to meet Argentine acceptance.

After four seasons Moore and Tudor arranged for Tom to visit the Massey-Harris Company to help develop a number of improvements for Argentine conditions. The next two harvest seasons were spent with test machines in the grain fields of Western United States. In 1917 the Massey-Harris Company opened a branch in Argentina and Tom became a direct employee, attached to the engineering department. He is now

(Continued on page 478)

MANY men help shape the transitions which mark human progress. Appraisal of specific phases of progress sometimes brings to light individuals whose cumulative contributions over a period of years add up to an influence meriting special recognition. In reviewing the progress of farm mechanization, and particularly the transition from animal to tractor power, the Jury of Awards found that Dent Parrett has made a succession of contributions to farm tractor design truly amounting to "Exceptional and Meritorious Engineering Achievement in Agriculture."

The period of his contributions covers the half-century from the heyday of the steam-powered threshing engine to the present. In range of technology, he contributed notably to progress in air cleaners, weight reduction, maneuverability, traction, pneumatic tire applications, variable-tread design, brakes, clutches, power take-offs, equipment mounting, and over-all design for performance and economy. Practicing agricultural engineering from a time before it was named or recognized, his design, development and refinement of mechanical features has directly or indirectly contributed to the performance and economy of a large majority of the tractors now available to American farmers.

Dent Parrett was born on October 13, 1886, the son of James and Mae (Stoner) Parrett, in Wenona, Illinois. He began working with farm implements while he was still in high school, for Harry Van Horn, in his farm implement store in Wenona. Van Horn let young Parrett repair and maintain the steam threshing engines he owned. A couple of Van Horn's customers even had steam plowing engines, and occasionally Parrett would get to work on them, too.

In 1908, after spending a year at the University of Illinois, Parrett opened his own machine shop and automobile agency in Wenona. He recalls selling three Rumely Oilpull tractors and an Aultman and Taylor 4-cylinder gas tractor during these early

Gold Medalists

The American Society of Agricultural Engineers Awards Annually the Cyrus Hall McCormick Medal for "Exceptional and Meritorious Engineering Achievement in Agriculture" and the John Deere Medal for "Distinguished Achievement in the Application of Science and Art to the Soil." Presentations of the 1958 Awards Were Made During the Society's 51st Annual Meeting at Santa Barbara, Calif., June 25.

The John Deere Medal was awarded to Wallace Ashby

WALLACE ASHBY

days of the tractor era. The Aultman and Taylor tractor pulled eight plows for a progressive local farmer.

Parrett had been intrigued with the possibilities of a light-weight, maneuverable tractor for farm use in place of the clumsy steam-powered engines, when he worked for Van Horn. In his machine shop, he began experimenting with new tractor design. In his own words, "I hired a young engineer from the University of Illinois to work out the design details for the first tractor I built. This engineer was a junior and worked during his summer vacation to design the tractor; it was finished about the time he returned to school for the fall term."

The first Parrett tractor was finished in time to help with the fall plowing in 1912. Encouraged by its success and the interest it stimulated, he organized the Parrett Tractor Company in 1913 at Ottawa. Some thirty tractors were built there between 1913 and 1915. In 1915 the Company was moved to Chicago Heights, where over three hundred tractors were built the first year, twice that number the next year, and again the next.

The dust problem gave Parrett's design inventiveness a real challenge. Dust entering the engine intake considerably shortened engine life. This threatened the future of the budding new tractor industry. He says, "We recognized the dust problem and were the first manufacturer to use the dry type of air cleaner as standard equipment. We soon found this only partially effective, which resulted in the development of the water type of cleaner."

Massey-Harris Limited of Toronto, already in 1916 prominent in the farm implement field, was eager to add a tractor to its line. In 1917 an agreement was reached whereby Massey-Harris would build a tractor from Parrett's specifications and drawings.

(Continued on page 478)

RAISED on an Iowa farm, Wallace Ashby has devoted his professional life to progress in the management and productivity of the soil. His career followed most notably an extension of soil science — farm structures — as important accessories to soil productivity.

Among his direct contributions to man's mastery of soil are a pioneer experiment in use of power equipment to bring under cultivation cutover lands in Minnesota, and in development of a method of describing and evaluating plow bottom shapes to aid in clean plowing for corn borer control.

In the improvement of buildings to serve with the soil, he and his associates, cooperating with representatives of other USDA agencies, state agricultural experiment stations, and industry, have conducted a long series of studies of the farmhouse, shelters for livestock, and storage structures for farm crops. The published results of these studies provide design data that are known and used all over the United States and in many other countries.

Wallace Ashby was born at Des Moines, Iowa, in 1890, the son of Newton B. and Harriet Wallace Ashby. Before settling on a farm near Des Moines in 1900, his father was national lecturer for the Farmers Alliance and the United States Consul at Dublin, Ireland, where Ashby spent his first year in school. His mother is the daughter of the founder of Wallaces' Farmer, and was herself on the editorial staff for several years.

In 1909 Ashby entered Iowa State College, in the Department of Agricultural Engineering, which had recently been organized by Prof. J. B. Davidson. His class of 1913 was the first to enter the professional course as freshmen, earlier graduates having transferred from other curricula. While at Iowa State, he was elected to membership in Delta Tau Delta, social, and Gamma Sigma Delta and Phi Kappa Phi, honorary fraternities.

After graduation he taught classes at Iowa State for a year in surveying, land drainage, and use of concrete. Then, from 1914 to 1917 he was employed by the USDA as "barn architect," the first person to serve in that capacity. From 1917 to 1919 he served as Lieutenant and Captain of the 304th Engineers, 79th Division, AEF, with which he saw combat service in France. One of the few memberships he indulges is in the 304th Engineers Association.

Returning to civilian life in 1919, he was employed as agricultural engineer for the land departments of two railroad companies, which owned land grants totaling ½ million acres of swamp and cutover lands, in Northern Minnesota, a considerable part of which had been burnt over in 1918. His work on this land development project was recognized by granting of the professional degree of Agricultural Engineer by Iowa State College in 1924.

Ashby returned to the United States Department of Agriculture at Toledo, Ohio, in 1928, to help meet a new problem, the European corn borer. Assigned to a study of clean plowing of infested cornstalk land to stop the spread of borers to the next year's crop, he and his fellow workers tested the covering ability and draft of almost every plow bottom that was then available. One result of this work was a method of describing and evaluating plow bottom shapes to aid in the selection of plows with good covering ability.

Recalled to Washington in 1931 by Dr. S. H. McCrory, Chief of the new Bureau of Agricultural Engineering, Ashby headed an enlarged program of farm building research and has continued in that capacity through several changes in organization and administration. From crop storages to livestock shelters, to housing for the farm family, he has worked to make farm buildings partners with the soil in delivering food and fiber for human use. Briefing the 1931-41 period with due professional modesty, he credits the teamwork of the whole

(Continued on page 478)

. . . Gold Medalists

Thomas Carroll

(Continued from page 476)

chief engineer of the Company's Harvesting Section.

Carroll's most spectacular achievement in a career studded with design firsts is the self-propelled combine. His principle of self-propulsion inaugurated a new era of self-propelled farm implements which has been extended to corn pickers, forage harvesters, picker-shellers, and many other machines. One of agriculture's most puzzling problems —how to maintain an adequate supply of stand-by manpower for seasonal tasks such as harvesting—took a big jump toward the goal of solution.

Many countries of inadequate food supplies find the self-propelled combine a major step toward stepping up food production. The combine has revolutionized rice harvesting in many countries where rice is the biggest item in the diets of the poor.

Carroll's desire to help underdeveloped countries mechanize their food production led him to achieve considerable ability as a linguist. He can express himself sufficiently to travel, talk to the farmers, and direct mechanics in Spanish, French, and German.

His sympathy for the less-mechanized countries, those which he knew would be using his combines as mechanization progressed, caused him to insist on the maximum design simplicity with minimum adjustments. This goal was heightened by an incident with an Argentine farmer who had bought a Massey-Harris combine. The combine had been giving the farmer some trouble, so Carroll looked it over. Carroll, as he carried out his inspection, would ask the farmer, "Why did you make this adjustment?" and "Why did you adjust that?"

Finally, the exasperated farmer, untrained in the mysteries of mechanization, blurted out, "Why did you put those adjustments there if you didn't want me to use them?"

Carroll's paper "Basic Requirements in the Design and Development of the Self-Propelled Combine" was presented at the ASAE Winter Meeting in December, 1947. It appeared in the Journal in March of 1948.

In reminiscing over Carroll's career, one Massey-Harris official voiced only one complaint. As soon as one combine design was off the drawing board and into production, Carroll was already back at work on further improvements. Never could Massey-Harris sit back, relax, and say, "This is the way we will build our combines for the next few years."

Another Carroll development that has pace-set combine design is his adaptation of the rasp-bar cylinder and slatted concave threshing unit. His rasp-bar cylinder design is now standard on most combines.

Such a full business life as Carroll has led leaves little time for hobbies, sports, or community service. But in his busy life he has yet managed to find time to indulge and perfect several after-hours projects.

Standing second only to his passion for farm implements is his passion for flying. Carroll's cross-continent jaunts have logged up well over a million and a half miles of air travel. He is an admiral of the Flagship Fleet of American Airlines and a distinguished member of the Pan American Clipper Club.

One of the first things Carroll does after reaching home base in Toronto is to head out to the Toronto Flying Club for an afternoon of solo flying.

A few years ago the Transport Commission of Canada ruled that pilots of private planes must pass a stiff examination before they could be licensed. Carroll was one of the few from the older crop of flyers to make the grade.

At one time in his life, Carroll was an enthusiastic golfer, and shot an excellent game. But, with typical insistence on perfection, he gave up the game because he didn't have the time to keep up his game in top shape.

On a recent field trip to North Africa, lunch time found Carroll and a colleague resting on a ledge that once had been the stage of a Roman theater. A town, built by the Romans in the historic days of their world-wide colonizations, had been situated on the side of the mountain where the two men rested. All around them, natives were cutting wheat with sickles—just as their ancestors had cut the wheat 2000 years ago. Below them, at the foot of the mountain, a combine traveled swiftly and efficiently through another wheat field.

Carroll, looking down at the combine, mused, with typical modesty, "Well, I guess it's all been worth while," and went on munching his sandwich.

Dent Parrett

(Continued from page 477)

Other companies, too, copied Parrett's tractor so meticulously that some of the parts were actually interchangeable with those of the Parrett tractor.

The Parrett tractor was demonstrated in the national tractor demonstrations, and occasionally Mrs. Parrett would drive the tractor with a plow, for two or three rounds. This made quite a hit with the farmers. A colleague recalls one of Parrett's demonstrations when the Parrett tractor dramatically proved its superiority. Parrett, on his tractor, a new high-wheeled model, pulled logs up and down and across a nearby creek. His competitors, driving the small-wheeled tractors typical of the period, couldn't begin to follow him in this difficult maneuver.

Shortly after the outbreak of World War I, Parrett was commissioned a captain in the Ordnance Department. He was in charge of engineering, production and inspecting of all engines and artillery tractors built by the Holt Manufacturing Company of Peoria—now the Caterpillar Tractor Company.

Engines for these tractors were built by three different suppliers. Military requirements specified that the engines should be so designed that they could be serviced from the same parts, and Parrett had the tough job of working out the details with the various suppliers.

While he was in the service, his tractor company business went downhill, and in 1919 he sold out and began working independently as a consulting engineer. Massey-Harris hired Parrett in 1920 to design a larger tractor than the earlier model and to supervise the building of experimental tractors from his new designs.

In 1923, Parrett designed a light cultivating tractor, later produced by the Continental Company of Springfield, Ohio. Parrett used a Ford engine in this tractor—and became a close friend of another imaginative pioneer in the automotive field—Henry Ford. This light tractor sold as part of a complete cultivating unit. One model pulled a single-row cultivator with the operator in the cultivator seat guiding the tractor. Another model had the cultivator mounted on the tractor. Several thousand of these cultivating units weie sold. He also designed for Continental, a mounted corn picker—the first quickly mountable picker ever produced commercially.

The variable-tread tractor he designed in 1929 was the first ever to produce adequate horizontal and vertical row crop clearance.

The Parrett-designed rubber-tired tractor hit the market just about the same time in 1932 as one built by a competing company. Records aren't clear on which tractor can claim the honor of being first—but it was obviously a pretty close race.

In 1938, Parrett became associated with Auto Specialties Manufacturing Company in St. Joseph, Michigan, to work out an adaptation of a disc brake for tractors. Evolving out of this assignment was the Parrett-designed double disc brake—now standard on about half of the wheel-type farm tractors built in this country.

In 1946, also for Auto Specialties, he developed a high-capacity clutch that could interrupt the drive to the final drive pinion to give the tractor a continuous running power take-off with little basic change in tractor design. Thousands of these clutches are in use today.

Added to the list of his achievements must be an item to cover the inspired leadership Parrett has given to young engineers fortunate enough to work with him. It is hardly surprising that one went on to become chief engineer at Ford Motor Company, another chief engineer at Allis-Chalmers Manufacturing Company.

His only son, too, has followed his father's lead and is now a consulting engineer. The Parretts have three grandchildren.

The solution of tractor design problems has not dampened Parrett's enthusiasm for the outdoors. Golf, hunting, fishing, canoeing, camping—Parrett has explored the best spots for each in many parts of the United States.

Wallace Ashby

(Continued from page 477)

division with some of its major accomplishments, in the following words:

"In 1931, we assisted in the preparation of reports for the President's Conference on Home Building and Home Ownership under the leadership of Herbert Hoover. In 1934, we assisted in the Farm Housing

(Continued on page 490)

51st Annual ASAE Meeting

The 51st Annual meeting of the American Society of Agricultural Engineers, held on the Santa Barbara Campus of the University of California, lived up to all advance billing. Members of the Pacific Coast Section, hosts for the five-day convention, went all out to make the meeting a huge success — even to the point of getting full cooperation from the weatherman.

Registration reached approximately 1000 including women and children, with twelve foreign countries being represented. Visitors were awed by the scenic beauty of the 408-acre Santa Barbara Campus located at the base of the Santa Ynez mountain range and overlooking the Pacific Ocean. Campus recreational facilities including a pool as well as beaches for swimming and sun bathing were available to members throughout the meeting as mild summer climate prevailed.

Preliminary activities started Saturday, June 21, with the Council opening its meeting at 2:00 p.m. at the Carillo Hotel in Santa Barbara. Registration began Sunday at 10:00 a.m. at Santa Rosa Hall on the campus. The major discussion at the Cabinet meeting held at 3:00 p.m. on Sunday was on the subject of better section programs. C. S. Morrison of the Quad City Section and C. L. Hamilton of the Washington, D.C. Section reported on local sections; C. B. Richey of the Michigan Section and a tape recording by A. W. Cooper and executive committee of the Alabama Section reported on state sections, and J. B. Rodgers of the Pacific Northwest Section and R. E. Patterson of the North Atlantic Section reported on regional sections. Much interesting and valuable information for improving section programs was exchanged. A transcript of the Cabinet meeting minutes may be obtained from ASAE headquarters.

C. J. Steinbrunner (left), product manager, New Idea Farm Equipment Co., is congratulated by Curry W. Stoup, president of New Idea, on 40 continuous years of service with the company. Mr. Steinbrunner is responsible for coordinating sales, service, and engineering activities related to New Idea products

Dean John C. Snidecor, University of California, Santa Barbara, welcomed the group Sunday evening at a buffet dinner held in the Dining Commons building. Following the dinner a colorful Spanish combo with dancing Senoritas provided special entertainment.

Meeting Sessions

Concurrent sessions were held all day Monday for each of the four divisions of ASAE, student program, and the special soil and water program for public lands and public works. An extension seminar, with Frank W. Andrew presiding, was held Monday morning. Again on Tuesday morning divisional sessions were in progress.

Organized tours and special events were well attended. Tours of divisional interest were held Tuesday afternoon and special tours for the ladies included the Santa Barbara Mission, the famed "Queen of the Missions" and the Botanic Gardens. A huge crowd enjoyed tasty steaks at the barbecue dinner held in Tucker's Grove Tuesday evening. Outdoor dancing to Western style music followed.

Business Meeting

J. R. Tavernetti, chairman of the meetings committee, presided at the General Session, Wednesday afternoon. L. M. K. Boelter, dean of college of engineering, University of California, Los Angeles, spoke on "Education for Professional Engineering." The presidential address, by Earl D. Anderson, which followed, was entitled "Charting the Second 50 Years." See page 395, July issue, for complete address. Robert Mensch, Iowa State College, presented his paper, "A New Principle for a Continuously Variable-Speed Transmission," which was selected as first place in the student paper award contest.

Annual Dinner

The ASAE annual dinner program was held Wednesday evening with K. L. Pfundstein, The Ethyl Corp., as master of ceremonies. L. J. Fletcher, former president of ASAE, was principal speaker and gave a most interesting talk on International public relations entitled "From Where I Stand." The famed Romany Chorus of Santa Barbara presented several fine selections. Thomas Carroll, chief combine engineer, Massey-Ferguson, Ltd., and Dent Parrett, consulting engineer, Auto Specialties Co., received the Cyrus Hall McCormick Medal; and Wallace Ashby, chief, livestock engineering and farm structures research branch, (AERD, ARS) USDA, received the John Deere Medal.

Student Activities

The following officers were elected to serve on the National Council of ASAE Student Branches for 1958-59: President, Robert Mensch, Iowa State University; 1st vice-president, Richard Holdren, Ohio State University; 2nd vice-president, Lex Strickland, University of Georgia; secretary, Marvin Gerdes, University of Illinois. The FEI Student Dinner was held Monday evening at the Hotel Carillo in Santa Barbara. Ernest C. Hart, president of Food Machinery and Chemical Corp., in his address to the students pointed out the prerequisites for engineers entering into industry.

Group A winner of the Farm Equipment Institute trophy award was presented for the third consecutive year to the Georgia Student Branch, honorable mention for this group going to the Iowa and Pennsylvania Student Branches. The Maine Student Branch received honors as winner in the B Group for the second consecutive year with honorable mention given to the Alabama and Texas Student Branches.

These trophies were presented to the two student branch groups, Group A including the larger branches and Group B the smaller, in recognition of outstanding initiative and accomplishment in ASAE Student Branch activities. Awards were made by the Committee on FEI Trophies.

First place award in the student paper contest was presented to Robert L. Mensch of Iowa State College. His manuscript entitled "New Principle for a Continuously Variable-Speed Transmission" was presented during the annual business meeting.

Second place winner, Jerry R. Lambert of the University of Florida presented a paper entitled "A Study of the Performance Characteristics of a Low-Lift High-Volume Farm Pump." Ronald Clarence Carver of the University of Illinois was third place winner. His subject was "A Pressure Cap for the Tractor Fuel Tank."

A special program for public lands and public works extended through Thursday. A separate report on the extension exhibits, student honor award winners and Journal paper award winners will appear in an early issue.

New Award Offered

A new award "For Outstanding Achievement in Farm Buildings" has been established by the Metal Building Manufacturers Association. It is to be administered by the American Society of Agricultural Engineers.

In accordance with the expressed wishes of the Association, the award is to be made annually to an ASAE member in good standing and under 45 years of age. The age limit emphasizes the purpose of the award to recognize professional achievement by young engineers in the farm structures field.

Elements of the award include a diploma or certificate and an engraved presentation watch to the winner, and a plaque with appropriate citation to the institution from which the individual received his bachelors degree.

It is anticipated that the first presentation of this award may be made at the Society's Annual Meeting in 1959. The jury for the award is currently in the process of organization.

Photo High Lights
of 51st Annual Meeting

Santa Barbara, California

June 22 to 26, 1958

(Top left) Retiring President Earl D. Anderson chats with Professor and Mrs. Henry Giese from Iowa State College. *(Lower left)* Interest in papers was high with pretty co-eds Jo Anne Du Puis and Gail Flemming in the paper distribution room. In foreground is Jerry Isaacs from Purdue University. In background are Mills Byrom, Belle Glade, Fla., and Jesse E. Harmond, Oregon State College

(Below) Eating family style are the Edminsters, left to right, Talcott, Mrs. Edminster, Gail, Vicki, Linda, and T. W. Edminster, SWCRD, ARS, USDA, Plant Industry Station, Beltsville, Md.

(Right) Serving themselves at the buffet table in the dining commons of Santa Barbara Campus are G. C. Zoerb, South Dakota State College; Dean M. H. Folk, Jr. and J. J. McDow, Louisiana Polytechnic Institute; and Mrs. and Mr. Clarence Jensen, Fresno State College, Calif.

Planned Tours

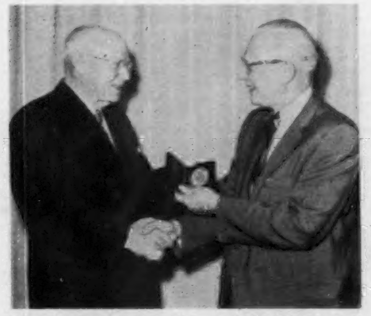
Conducted tours were well attended. On the Power and Machinery tour members saw walnut harvesting equipment, at left, and lemon tree pruning equipment, at right

Annual Banquet

L. J. Fletcher, retired vice-president of Caterpillar Tractor Co. and past-president of ASAE, gave an inspiring address on international public relations during the annual dinner program

Inauguration of the new president took place following the annual dinner. Dr. E. G. McKibben, director of Agricultural Engineering Research Division, Agricultural Research Service, U.S. Department of Agriculture *(left)*, accepts the gavel from Retiring President Earl D. Anderson, director of agricultural extension, Stran-Steel Corp.

Gold Medalists



Recipients of the Cyrus Hall McCormick Medal were Thomas Carroll, chief combine engineer, Massey-Ferguson Ltd. *(above)*, and Dent Parrett, consulting engineer, Auto Specialties Co. *(right)*

(Above) The John Deere Medal was presented to Wallace Ashby, chief of livestock engineering and farm structures research branch (AERD, ARS), USDA. Presentations were made by Retiring President Earl D. Anderson

Student Activities

Officers elected for the National Council of Student Branches were *(left to right)* Marvin L. Gerdes, University of Illinois, secretary; Lex W. Strickland, University of Georgia, 2nd vice-president; Richard D. Holdren, Ohio State University, 1st vice-president; and Robert L. Mensh, Iowa State College, president

FEI Trophy Awards for ASAE Student Branch Activities were presented during the student banquet sponsored by the Farm Equipment Institute. *(Left to right)* Frank P. Hanson, banquet toastmaster; Lex W. Strickland, University of Georgia (Class A winner); Kermit O. Allard, University of Maine (Class B winner); and Earl C. Musser, chairman of Committee on FEI Trophies

William E. Knapp became chief engineer of the John Deere Killefer Company located in Los Angeles, Calif., on July 1, 1958. He was transferred to the Los Angeles factory from the John Deere Plow Works of Deere & Co. located at Moline, Ill. Prior to his employment with the John Deere Plow Works, he was employed as chief engineer of Minneapolis-Moline Co.

Joseph R. Jones, previously connected with A. & M. College of Texas as assistant agricultural engineer in Cotton Ginning, has accepted a position as instructor at Texas Technological College of Lubbock, Texas.

Gerald T. Ward has accepted a position in the engineering department at the University of Malaya in Singapore. Formerly he was visiting assistant professor at the University of California.

Edward M. Norum, formerly of Minneapolis, has returned to his previous place of employment as assistant project engineer with the Experiment Station, HSPA, Honolulu. From 1953 to 1957 he served there as an associate agricultural engineer.

James E. McAlexander has accepted a position with the Northwestern Mutual Life Insurance Co. of Milwaukee as supervisor of farm mortgage loans in the Delta Region of Arkansas and Missouri. Formerly he was sales manager of Delta Irrigation Co. of Memphis.

V. A. Tanksale, a recent graduate of Kansas State College, is now a lecturer at the College of Agriculture in Bombay, India.

Eugene D. Baker, Caterpillar Tractor Co., has recently been promoted from research engineer to supervising engineer in charge of the testing and development of D8 crawler tractors at the Peoria, Illinois, proving ground.

Thomas E. Wales, Jr., previously an instructor in the agricultural engineering department of California State Polytechnic College at San Luis Obispo, is at present associated with George S. Nolte, Consulting Civil Engineers of Palo Alto.

H. Albrecht Sack has been transferred from John Deere Research and Engineering Center, Waterloo, Iowa, to John Deere Argentina, S.A.I.C. in Buenos Aires, Argentina.

Hans Sack has been called as professor of agricultural engineering at the Technical University at Aachen, Germany to serve as director of the Institute of Agricultural Engineering. Previously he was director of engineering in the implement division of Hanomag Tractor Works in Hanover, Germany.

R. C. Leary

F. R. Jones

R. C. Leary has been promoted to manager of the Service Department, Tractor and Implement Division, Ford Motor Co. He joined the company in June 1947, serving as senior service engineer for the Ford Division before joining Tractor and Implement Division in 1954 as assistant service manager.

Fred R. Jones has announced his retirement, effective September 1, as head of the department of agricultural engineering of the Texas A. and M. College System after almost 40 years of service. A native of Mauston, Wis., he joined the department in February 1921 as an instructor, and became department head in 1940. Since that time he has taught one or more courses to the more than 700 graduates who have majored in agricultural engineering and are now active in almost every country in the world.

He is a graduate of the University of Wisconsin, receiving a B.S. degree in 1915. During the next two summers he was associated with International Harvester Co. as field expert, and served as an instructor in agricultural engineering at the University of Wisconsin for the school term. In 1917 he became extension specialist in agricultural engineering at Mississippi A. & M. College, until January 1918, at which time he assisted in grain dust explosions investigations with the U.S. Department of Agriculture. After a year spent with the Air Service of the U.S. Marine Corps, he was employed as sales representative by Advance-Rumely Thresher Co. and John Deere Plow Co. until January of 1921.

Mr. Jones is the author of a widely used college textbook, "Farm Gas Engines and Tractors," and numerous other articles and publications on agricultural engineering. In retirement he and Mrs. Jones plan to continue their residence at 201 College View in Bryan, Texas, and he plans to utilize his time in the cattle ranching business.

Peter C. Coates, former agricultural field representative of Stran-Steel Corp. of Detroit, has become general manager of Peoria Steel Buildings, Inc. of Washington, Illinois.

Gordon H. Smith is now employed as test engineer with Firestone Tire & Rubber Co. of Ft. Stockton, Texas. Formerly he was general manager of Imperial Farms.

C. W. Saldeen, formerly employed as product designing engineer of the Tractor & Implement Division of Ford Motor Co., has accepted a position with Fafnir Bearing Co.

P. John Zachariah, having completed requirements for an M.S. degree in agricultural engineering at West Virginia University, has rejoined Stanes Motors Ltd. of Coimbatore, South India, as manager of their tractor department. They are the main dealers for Massey-Ferguson tractors and machinery in South India.

NECROLOGY

Professor Frazier Rogers Dies on Eve of Retirement

Professor Frazier Rogers, head of agricultural engineering department, University of Florida, whose July 31st retirement from the University after 40 years' of active service was announced recently, died July 22 while enroute to Alachua General Hospital.

Frazier Rogers

As head of the agricultural engineering department since 1923, he was senior employee of the University in total years of service and had joined the staff in 1918.

Professor Rogers was born February 7, 1893, in Ora, Miss. He graduated from Mississippi State College in 1915 and completed an M.S. degree at University of Florida in 1930.

He was vice-president of the board of directors of the University of Florida Athletic Association and has been a member of the group since 1922. He also was a member of the First Baptist Church.

At the time of his death, plans were being made for a surprise public recognition of Professor Rogers, honoring him for his long and illustrious years of service. A formal presentation of his portrait was to be made and presented at this time, to be displayed in the agricultural engineering department of the University.

He is survived by his wife, Gladys, three daughters and two sons. Burial was in the Evergreen Cemetery in Gainesville, Fla.

John G. Taylor, agricultural engineer with the Farm Electrification Research of AERD, USDA, Purdue University, died June 14 in an automobile accident near Chillicothe, Mo.

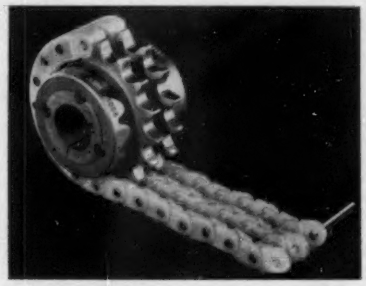
John G. Taylor

Mr. Taylor was born on a farm near Wyalusing, Pa., and he received a B.S. degree in agricultural engineering from Pennsylvania State University in 1942. Following graduation he joined REA. He left after two months to work as a civilian for the U. S. Army Signal Corps. After one year he enlisted in that branch and served as a radar technician. He returned to REA after his release from military service in 1946 and accepted the position with the Agricultural Research Service, USDA, in 1947. He continued his education at Purdue, receiving an M.S. degree in agricultural engineering in 1951. His work with the Research Service dealt primarily with determining requirements of electrical radiant heaters for pigs and chicks and the developing of necessary equipment and controls. He was known also for his research on electric lamps and traps for insect attraction and control. In 1956 he was awarded a public patent on a proportional time-temperature controller.

He joined ASAE in 1942.

New Flexible Nylon Coupling

Morse Chain Co. has added a new, lubrication-free nylon coupling to its line of flexible couplings. Said to be corrosion-



resistant, the chain element of the new coupling is constructed of nylon segments and stainless steel pins. It can be disassembled or connected at any link without special tools, and fits standard, stock steel roller chain sprockets. The new coupling reportedly handles loads from fractional to 40 hp and speeds from 500 to 5000 rpm. Complete couplings (½-in. pitch links and soft steel sprocket), or chain elements are available.

(For more facts circle No. 19 on reply card)

Self-Computing Dynamometer

M & W Tractor Products recently announced a new hydra-electric dynamometer for testing tractors. The new model is said

to automatically compute horsepower of any tractor at any rpm without mental or paper calculation. Ease of operation is stressed in the unit's design. The horsepower gage and rpm tachometer are in one compact portable panel that lifts out of the dynamometer for easy reading at either side of the tractor. One small electrical cable is the only connection from the dynamometer to the portable instrument panel.

(For more facts circle No. 20 on reply card)

Introduces New Line of Stationary Power Units

Deere & Co. has introduced a new line of stationary power units, available in three sizes, for irrigation and other uses. Included

are the 73-hp, 217 series; the 50-hp, 145 series; and the 29.3-hp, 92 series. These are reported as maximum horsepower ratings for intermittent use, corrected to standard atmospheric conditions. All units are designed to use standard-grade gasoline.

The 217 series units are of 6-cylinder design, with 3⅜-in. bore, 3½-in. stroke, and 217 cu-in. displacement. The 145 series engines are of 4-cylinder design with 3⅜-in. bore, 3½-in. stroke, and displacement of 145 cu in. The 92 series engines are of 4-cylinder design 3⅛-in. bore and 3-in. stroke, with 92 cu-in. displacement. Illustrated from left to right are 217, 145 and 92 series, respectively.

(For more facts circle No. 21 on reply card)

Liquid Fertilizer Attachments for Corn Planters

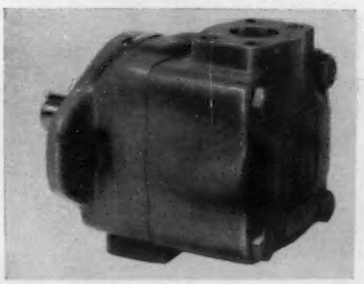
International Harvester Co. has announced availability of a new liquid fertilizer unit for use on 4-row McCormick No. 449 and

450 corn planters. The new unit is said to meter non-pressure liquid fertilizer at rates from 45 to 890 lb per acre, depending on meter setting and travel speed. Liquid, carried in 50-gal steel tanks, feeds through individual metering heads and plastic tubes to single disk or split-row fertilizer applicators for each row. Filler caps in the tanks are specially vented to create a partial vacuum regardless of liquid level. A clear plastic liquid-level-indicator tube on the front of each tank lets the operator know the fertilizer supply at a glance.

(For more facts circle No. 22 on reply card)

Increases Power, Reduces Size in New Hydraulic Pump

Vickers Incorporated has developed a new line of vane pumps for construction and materials handling equipment. The company



states that the new pump series delivers more power in relation to cost and package size than previous models through use of increased speeds and pressures. The first model of this new series is said to provide outputs of 25.2, 20.4 and 17.8 gpm, respectively, at 2000 psi and 2000 rpm. Overall envelope size is 4⅜ x 5¾ x 5⅜ in. Performance figures are said to allow a horsepower absorption capacity of up to 36 hp.

The company states that by operating the hydraulic system at higher speeds and pressures, size reduction of hydraulic components (lines, valves, and actuating cylinders) is possible. A feature of the new pump keeps starting load on the tractor engine at a minimum by automatically retracting the pump vanes at engine cranking speeds. As the engine fires and reaches idle speed,

centrifugal force and system pressure extend the vanes to start and maintain pumping action.

(For more facts circle No. 23 on reply card)

Seat Leveling Device

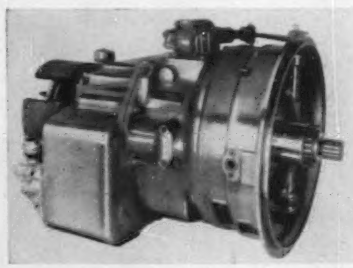
Lev-O-Matic Corp. has developed a new tractor seat attachment designed to cushion jolts, jars, shocks of hills, furrows or

slopes. Featured is a weight adjustment assembly that permits tractor operator to adjust the unit for individual comfort and safety. The manufacturer reports that the device attaches to any standard tractor seat and is interchangeable with other farm equipment.

(For more facts circle No. 24 on reply card)

Combined-Drive Transmission

Dana Corporation has announced a new, fully automatic transmission which in a unit assembly combines a hydraulic torque



converter with a forward and reverse gear arrangement and a straight-through drive. The new unit, called the Model 183 Spicer Turbo-Matic transmission, is said to provide high normal drive efficiency combined with ability to deliver a smooth flow of power and rapid acceleration under variable load conditions.

Starting with a torque ratio of 5.5 to 1 in fluid drive (depending on application) and graduating down through the direct drive or lock out range, the new transmission delivers an uninterrupted flow of power to the driving axle. Vehicle acceleration from start regardless of load is directed entirely through the torque converter without the aid of any gearing. As the transmission approaches a 1 to 1 torque ratio, a full-power shift is automatically made to direct drive. This shift is accomplished by hydraulically actuating a multiple-disk clutch. In direct drive, the power flow is transmitted, via the through shaft, direct into the propeller shaft. It bypasses the converter section entirely.

(For more facts circle No. 25 on reply card)

Newly Formed Baton Rouge Section

The Baton Rouge Section met March 3 to appoint a temporary executive committee to draw up by-laws and make provisions for putting their section into active operation. These by-laws were ratified unanimously by members present at a second meeting held March 17. On March 31, at a third meeting, the following permanent officers were elected: chairman, C. H. Thomas; vice-chairman, J. L. Smilie; secretary-treasurer, F. T. Wratten, and acting junior chairman, H. T. Barr.

On April 18 and 19, the new section met with the Louisiana Agricultural Engineers Association in New Orleans.

North Atlantic Section

The North Atlantic Section extends a cordial invitation to members and families to attend the summer meeting to be held at Ontario Agricultural College, Guelph, Ontario, Canada. The program will include a number of outstanding speakers who will present topics of current interest.

The meeting date, August 25-27 has been scheduled to coincide with the Canadian National Exhibition in Toronto and the Shakespearean Theatre Festival. Program and registration information may be obtained by writing to C. G. E. Downing, Department of Engineering Science, Ontario Agricultural College, Guelph, Ontario, Canada.

Alabama Section

Plans for next year's activities were made at an executive committee meeting of the Alabama Section held June 12 at the API Agricultural Experiment Station.

The group set up a state water committee to study Alabama water resources and plans are being made for the committee to work with existing agencies and committees by giving technical assistance to aid in formulating policies. C. M. Sanders will serve as chairman.

A marketing committee was established with F. A. Kummer, API agricultural engineering department head, as chairman to study the state marketing situation and offer technical assistance in the engineering field.

Announcement of the Alabama Section's admittance to membership in the Engineers Club of Birmingham was made at the meeting and Section Chairman A. W. Cooper and Past-Chairman Joe Hixon, Alabama Power Co., Montgomery, were elected to represent the state ASAE Section.

Southeast Section

February 2-4, 1959, has been set for the Annual Meeting of the Southeast Section, to be held in Memphis, Tennessee. Plans are being formulated by the program chairmen for interesting and timely presentations. Letters have been mailed to the members requesting suggestions that might add stimulus to the program.

Mid-Central Section

An attendance of 128 exceeded any previous number to attend a Mid-Central Section meeting when it held its 11th Annual Meeting March 28-29 in St. Joseph, Mo. The two-day session included 26 technical papers, presented by members from the four-state area. Earl Anderson, Stran-Steel Corp. and ASAE president was present and addressed the group who attended the annual dinner as well as the student group.

The winning student paper, presented by Robert Mensch, Iowa State College, dealt with a new principle for a continuously variable speed transmission.

Officers elected for 1958-1959 are: C. L. Day, University of Missouri, chairman; E. A. Olson, University of Nebraska, J. D. Rector, Heinzman & Sons, and D. R. Hunt, Iowa State College, vice-chairmen; G. L. Kline, Marketing Research Division, USDA, secretary-treasurer.

West Virginia Section

West Virginia Section members held their annual meeting April 17. Officers elected for 1958-59 are as follows: chairman, J. L. Copeman; vice-chairman, W. H. Dickerson; secretary-treasurer, A. B. Holland.

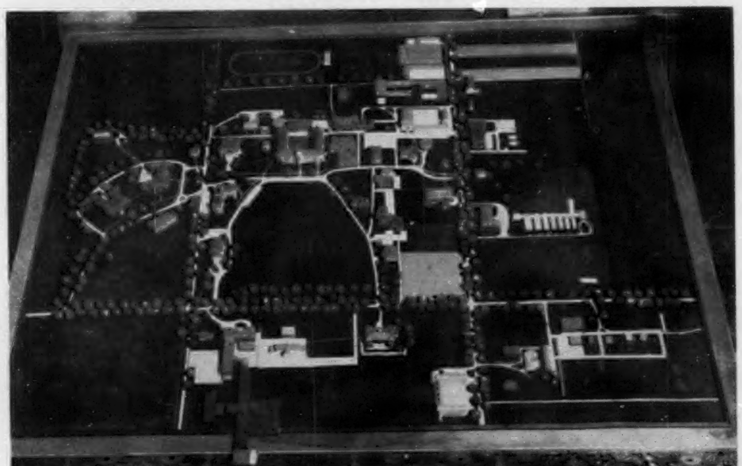
Pennsylvania Section

"Working Together" was the theme of the morning session of the Pennsylvania Section meeting held April 24 at Pennsylvania State University. Following the business meeting, Thursday morning, Dean M. A. Williamson, College of Engineering and Architecture, PSU, extended a greeting. Sterling Mudge, Socony Mobil Oil Co., spoke to the members on working together. Papers presented during the morning session included discussions on new concepts of brooding and ventilation, by W. A. Junnila; concrete tilt-up construction for farm buildings, by S. J. Myers, and mosquitoes and engineers, by Fred Knipe.

Nevin Brenner, Gulf Research Center, was toastmaster for the Thursday evening banquet at which Professor John E. Nicholas, retiring professor of agricultural engineering was honored for his 29 years of teaching and research at Pennsylvania State University.

After the ASAE Radiation Committee Report given at the Friday morning session by J. E. Nicholas, the following subjects were discussed by members of the university faculty: fundamentals of reactors, by C. H. Blanchard, associate professor of physics; radiation sterilization of milk products, by S. Patton, associate professor of dairy science; food preservation by radiation, by F. B. Thomas, assistant professor of horticulture, and neutron activation chromatog-

North Atlantic Section Meets in Canada



(Above) Model plan of the Ontario Agricultural College in Guelph, scene of the North Atlantic Section meeting to be held August 25 to 27

(Right) Officers elected for newly formed Baton Rouge Section are: *(left to right)* Joseph L. Smilie, vice-chairman; Carl H. Thomas, chairman, and Finis T. Wratten, secretary-treasurer

raphy, by Andrew Benson, associate professor, agricultural and biological chemistry.

Dean L. E. Jackson, College of Agriculture, PSU, greeted the members at the Friday luncheon and Elton Tait, TV Editor, also of the university, spoke on the topic, "Skul to Skull." Two concurrent programs, an atomic reactor tour, and open house at the agricultural engineering building featuring egg handling, by Howard Bartlett and David Beppler; hay handling, by Donald Daum, and displays and demonstrations by the agricultural engineering students followed.

The Honorable James E. Van Zandt of the Joint Congressional Committee on Atomic Energy was the speaker for the general meeting held in Schwab Auditorium. His subject was "Peace Time Uses of Atomic Energy."

Georgia Section

The Georgia Section Meeting was held at Panama City, Florida, April 25-27 with a deep sea fishing expedition highlighting the program.

New officers elected were: chairman, L. T. Wansley, manager, Rural Division, Georgia Power Co.; vice-chairman, G. N. Sparrow, Coastal Plains Experiment Station, and secretary, R. E. Skinner, Russell Daniel, Inc.

Ohio Section

The Ohio Section registered 53 in attendance at the Section Meeting held May 2-3. It was voted to offer a $25.00 prize for the outstanding paper from an Ohio State University student entered in the National ASAE Student Paper Award Contest for 1959. The winning student is to present his paper at the Spring Meeting next year.

Officers elected for 1959 are: chairman, R. P. Harbage; vice-chairman, C. L. Hahn; secretary-treasurer, W. L. Roller; nominating committee, W. H. Johnson, D. A. Garber and W. K. Richey.

The next meeting of the Section will be held October 17 and 18 on the campus of Ohio State University.

Iowa Section

Fifty-five members and guests were present at the Latin King Restaurant in Des Moines, May 16 for the dinner and program prepared by the Iowa Section officers.

The program included a paper by John King entitled "What's Going on Up There." Mr. Hawley of Goodyear Tire & Rubber Co. presented information on the Terra Tire followed by comments by Wayne Worthington who led a discussion on the paper.

The following officers were elected for 1958-59: chairman, D. L. Woolsoncroft; 1st vice-chairman (program), T. E. Hazen; 2nd vice-chairman (publicity), C. R. Aiken; 3rd vice-chairman (membership), R. H. Tweedy; secretary-treasurer, G. R. Sutherland; nominating committee, R. H. Meier, A. E. Powell and R. A. Loveland.

Minnesota Section

W. G. Shelley, vice-chairman of the Minnesota Section presided at the Section meeting held May 22 at the Dyckman Hotel in Minneapolis. The opening feature on the program was a movie on time, space, and steel, shown by A. E. Kvamme, Armco Drainage and Metal Products, Inc. This was followed by a presentation entitled "Material Handling — Make It a System" by S. S. De Forest, *Successful Farming*. A presentation on design implications of the 1000-rpm PTO on allied equipment was given by V. V. Nash, of The Farmhand Co. Following a half-hour recess a paper on trends in agricultural practices and farm machinery was given by E. A. Silver, New Holland Machine Co. Marvin Nabben, Northern States Power Co., spoke on the influence of electrical power on agricultural practices and agricultural buildings and their arrangement and L. F. Hermsmeier, USDA, gave the concluding talk in which he discussed the new soil and water conservation research station at Morris, Minnesota.

The new officers for 1958-1959 are: chairman, W. G. Shelley, Allied Engineering & Mfg. Co.; vice-chairman, C. H. Christopherson, University of Minnesota; secretary-treasurer, M. L. Gustafson, The Farmhand Co.; contributing editor, L. A. Liljedahl, USDA; director, MFES, V. M. Meyer, University of Minnesota; alternate director, MFES, A. E. Kvamme, Armco Drainage & Metal Products; nominating committee, M. Nabben, Northern States Power Co., C. K. Otis, University of Minnesota, and K. W. Westerberg, Farm Engineering Sales, Inc. and Westerberg, Inc.

Washington, D. C. Section

New officers elected at the Washington, D. C. Section meeting held June 13 are as follows: G. W. Gienger, chairman; L. E. Holman, vice-chairman; and H. J. Thompson, secretary-treasurer.

Chicago Section

A daylight meeting of the Chicago Section will be held Monday, September 8, at the Manufacturing Research Operation of the International Harvester Co. Proceedings including a movie, speaker, tour of manufacturing research and a business meeting will begin at 10:30 a.m. Meeting will be adjourned at 4:00 p.m.

George and Mrs. Amundson, flanked by their son Rolf and daughter Barbara, during special recognition dinner

George Amundson Honored

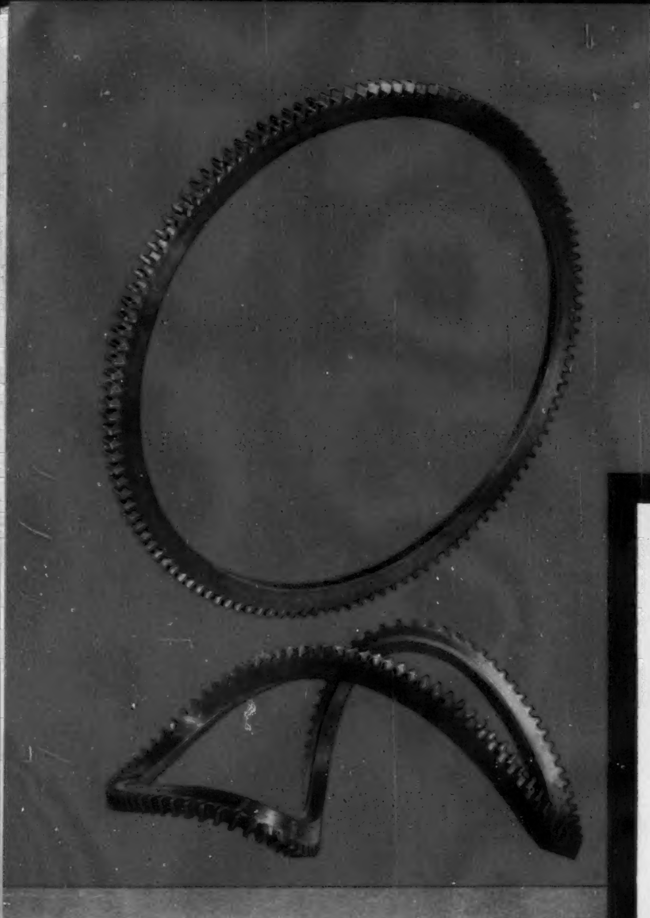
The agricultural engineering department at Michigan State University, members of the Michigan Section ASAE, and friends honored Mr. and Mrs. George W. Amundson, assistant professor of agricultural engineering, on May 24 at a special recognition dinner. Mr. Amundson retired July 1, after 36 years of service as extension specialist at MSU. Several gifts and a book of letters of congratulations from friends were presented during an illustrated "This Is Your Life" program. In tribute to George, the "George Amundson Award" was set up to be given to the winning Michigan 4-H high school student each year.

George Amundson is a native of Wisconsin and a graduate of the University of Wisconsin. His first work at Michigan State was as a land clearing specialist in the Upper Peninsula counties in 1922. He started work in farm buildings extension in 1925, and organized the first extension farm machinery repair project in Michigan in 1932. As early as 1931 he gave many irrigation demonstrations and later helped promote the Midwest Plan Service farm building catalog.

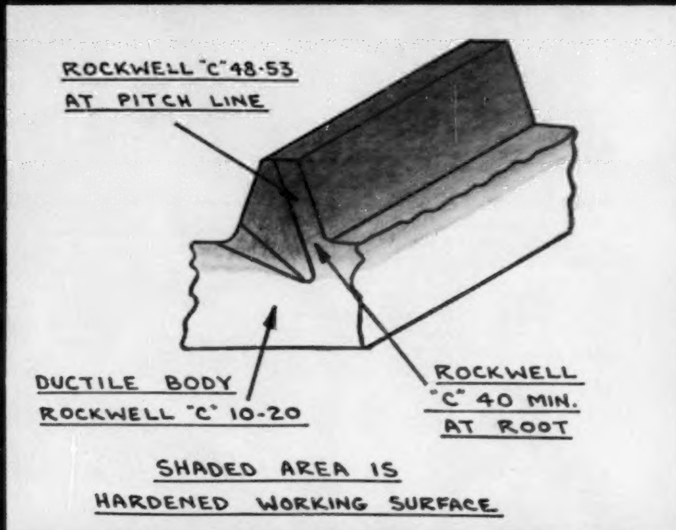
One of his many projects was to introduce the use of large bull-dozers for land clearing and was first to promote the use of high-pressure orchard spray rigs for fire protection.

He helped produce the Rural Progress Caravan, a traveling, educational show put on in 1946-47 for the purpose of showing the development of labor-saving devices for farms and was called by the National Cooperative Extension Service to travel throughout the United States and explain the Caravan idea. An active member of ASAE since 1927, he served as the first chairman of the joint college and industry extension committee.

The Amundsons expect to remain in East Lansing following retirement.



THIN! TOUGH! ...and "tender-hearted"



THE MANUFACTURE of flywheel ring gears poses special problems. Sectional thickness is usually less than three-quarters of an inch. To withstand the impact force of the starter pinion, the gear teeth must be hard. But the gear body itself should be unhardened so that it will conform tightly to the flywheel, and "give" under the stress that might snap a brittle gear.

Note how DOUBLE DIAMONDS are made to be thin, tough, "tender-hearted." The above photo of a gear twisted into a pretzel shape graphically demonstrates ductility. The sketch at right shows three important areas: the wide and deep hardness pattern, the generous area of transition, and the ductile body. These extremes are achieved in DOUBLE DIAMOND Flywheel Ring Gears by controlled selective heat treatment—all essential to flywheel ring gears that provide the best possible performance.

Our Engineering Department will be glad to make constructive suggestions on the design of flywheel ring gears, or on the many other types in which we specialize. Write, phone or wire—depending on the urgency of your need.

EATON

AUTOMOTIVE GEAR DIVISION
MANUFACTURING COMPANY
RICHMOND, INDIANA

GEARS FOR AUTOMOTIVE, FARM EQUIPMENT AND GENERAL INDUSTRIAL APPLICATIONS
GEAR-MAKERS TO LEADING MANUFACTURERS

(For more facts circle No. 66 on reply card)

If you are not a member of the American Society of Agricultural Engineers and want (1) to subscribe* to AGRICULTURAL ENGINEERING or (2) to receive information about ASAE membership—or if you *are* a member of ASAE and want to propose the names of one or more prospective members — then simply fill out and mail the card at the right.

(*NOTE: A subscription to AGRICULTURAL ENGINEERING is included in the annual dues of each ASAE member.)

CHECK

☐ I want to receive AGRICULTURAL ENGINEERING regularly. Enter my subscription for one year ($5.00 in USA; $5.50 in Canada; $6.00 elsewhere). Payment is enclosed.

☐ I would like information about membership in the American Society of Agricultural Engineers, including an application form. (I understand that a subscription to AGRICULTURAL ENGINEERING and a copy of AGRICULTURAL ENGINEERS YEARBOOK are included in the annual dues of ASAE members.)

☐ I am an ASAE member and suggest that membership information, including application form, be sent to the name and address below. I can supply names of ______ more prospective members. My name is ______

Name ______

Position or title ______

Address (☐ Home or ☐ Business) ______

City ______ Zone ______ State ______

Employed by ______

Use the card *below* for free data on new products and the card *above* for subscribing to AGRICULTURAL ENGINEERING, or for requesting information about membership in the ASAE.

LET US KNOW YOUR WANTS

Do you want more data or other information on products or catalogs advertised or otherwise featured in this issue? Then fill out one of the two mailing cards at the right and drop it in the mail today.

Our "Reader Information Service" clerks will see that your wants are promptly transmitted to sources of materials requested.

Kindly have mailed to me, without obligation, more information about items in this issue indicated by the numbers circled below:

AUGUST 1958

→ *Please print or type your name, etc., below* ←

Your name ______

Your position or title ______

Name of employer ______

Address of employer ______

City ______ Zone ______ State ______

New Products, New Catalogs, and Advertisements in AGRICULTURAL ENGINEERING

1	11	21	31	41	51	61	71	81	91
2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
9	19	29	39	49	59	69	79	89	99
10	20	30	40	50	60	70	80	90	100

Postage Will Be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 1 St. Joseph, Mich.

AGRICULTURAL ENGINEERING
P. O. Box 229
St. Joseph, Michigan

Reader Information Service

Postage Will Be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 1 St. Joseph, Mich.

American Society of Agricultural Engineers
P.O. Box 229
St. Joseph, Michigan

If you are not a member of the American Society of Agricultural Engineers and want (1) to subscribe* to AGRICULTURAL ENGINEERING or (2) to receive information about ASAE membership—or if you *are* a member of ASAE and want to propose the names of one or more prospective members — then simply fill out and mail the card at the left.

(*NOTE: A subscription to AGRICULTURAL ENGINEERING is included in the annual dues of each ASAE member.)

Use the card *below* for free data on new products and the card *above* for subscribing to AGRICULTURAL ENGINEERING, or for requesting information about membership in the ASAE.

LET US KNOW YOUR WANTS

Postage Will Be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 1 St. Joseph, Mich.

AGRICULTURAL ENGINEERING
P. O. Box 229
St. Joseph, Michigan

Reader Information Service

Kindly have mailed to me, without obligation, more information about items in this issue indicated by the numbers circled below:

AUGUST 1958

→ *Please print or type your name, etc., below* ←

Your name____________________

Your position or title____________________

Name of employer____________________

Address of employer____________________

City__________ Zone_____ State__________

New Products, New Catalogs, and Advertisements in AGRICULTURAL ENGINEERING

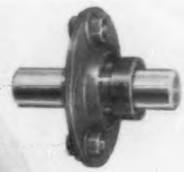
1	11	21	31	41	51	61	71	81	91
2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
9	19	29	39	49	59	69	79	89	99
10	20	30	40	50	60	70	80	90	100

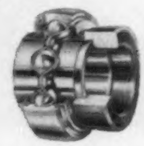
Do you want more data or other information on products or catalogs advertised or otherwise featured in this issue? Then fill out one of the two mailing cards at the left and drop it in the mail today.

Our "Reader Information Service" clerks will see that your wants are promptly transmitted to sources of materials requested.

BIGGEST SELF-PROPELLED COMBINE

John Deere 95 . . . big all the way through . . . the Fafnir equipped 95 offers a choice of 18, 16, and 14 foot platforms . . . has 40 inch feeder, 40 x 22 inch threshing cylinder, 40 inch separator, 60 bushel grain tank, and 80 h.p. John Deere engine.





FAFNIR BEARINGS ASSURE MAXIMUM CROP HARVESTING-MINIMUM SERVICING

The John Deere 95 Self-Propelled Combine takes a big cut! It's built to cut friction in a big way, too—with Fafnir ball bearings at 23 critical turning points.

The famous Fafnir Flangette with Plya-Seals is used at 11 locations. Prelubricated at Fafnir, this low-cost, easily installed ball bearing "package" never needs to be relubricated. The highly-protective contact seals lock lubricant in, contaminants out.

From platform drive to unloading auger, other Fafnir ball bearings—effectively sealed for trouble-free farm service—help conserve power and minimize maintenance.

Strategic designing anyway you look at it! And a good example of the way Fafnir meets the antifriction needs of farm equipment manufacturers—no matter how "big" the assignment. Worth bearing in mind! The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

(For more facts circle No. 65 on reply card)

. . . Gold Medalists

(Continued from page 478)

Survey of 622,413 farmhouses, carried out by the Works Progress Administration in cooperation with 46 state colleges. The survey stimulated preparation of plans and publications on planning and remodeling farmhouses. We worked in close cooperation with the Bureau of Home Economics and a number of the state colleges in preparing a series of 40 plans that were described in Farmers Bulletin 1738, and distributed through the State Extension Services. We now see very similar features in many of the plans for suburban houses in the popular magazines.

"With the setting up of the Ever-Normal granary program in the early years of the Roosevelt Administration, we received funds to begin a long series of studies of the storage of corn, small grain, grain sorghum and soybeans in farm-type bins. This research proved the practicability of long-time grain storage in farm-type bins and developed functional requirements for design of grain storage buildings that have been widely used by the CCC in its grain storage programs and by farmers."

A World War II project saw Ashby, as assistant director of the Hemp Division, Commodity Credit Corporation, helping Dr. McCrory direct a program for production of American hemp to supplement scarce supplies of manila fiber. The main supply of fiber from the Philippines was, of course, cut off after the Pearl Harbor attack.

After World War II, the Agricultural Research and Marketing Act provided funds for basic studies of the effects of housing conditions on the growth, production and feed consumption of cattle, swine and poultry. These studies, which involve both engineering and animal physiology, are cooperative with the Animal Husbandry Research Division of ARS, USDA and the Missouri and California Agricultural Experiment Stations. They have provided basic information needed in design of livestock shelters and ventilation systems that has not been available from other sources, and that has been widely used in this and other countries.

One of the most rewarding experiences in his career, according to Ashby, was his visit to the First International Congress on Farm Building Research at Lund, Sweden, in 1956. There he met with 60 men from 14 countries in Northwestern Europe to discuss farm building problems. After the Congress, Mr. and Mrs. Ashby visited 7 European countries to study their research and development work on farm buildings. The trip convinced Ashby of the need for closer contact with other countries through exchange of personnel and publications, and for better facilities for translating reports into different languages.

A member of ASAE since 1916, he has served almost continuously on one or more of its committees beginning with the Committee on Ventilation of Farm Buildings. While on the land-clearing project in Minnesota, he served on the Land Development Committee, then an important activity of the Society. For the Society Year 1940-41, he was chairman of the Farm Structures Division. More recently, he took his turn as chairman of the Washington, D. C. Section. He is currently chairman of the Committee on Farm Structures Research Needs and Statistics. His long and faithful service in the Society has been recognized by its Council which has advanced him to the status of Life Fellow.

The Ashbys have five children and nineteen grandchildren. Their two sons are both interested in agriculture. One has been in cotton marketing research with USDA. The other teaches Botany at the University of Chicago.

Utilizing his knowledge of structures in one of his hobbies, Mr. and Mrs. Ashby have built a retirement home at Scientists Cliffs on Chesapeake Bay, where they invite the children and grandchildren to visit them each summer.

Ashby has authored or co-authored a dozen USDA publications, ten Journal articles, and several other publications. His fellow workers are quick to point out that this list would be longer if his modesty didn't prevent his taking credit for much of the work he inspired and directed throughout his years of leadership.

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Ashford, Robert L. M.—Livestock inspector, Canada Dept. of Agriculture. (Mail) 534 Huron St., Toronto 5, Ont., Canada

Bell, Jack F. — Territory supervisor, J. I. Case Co. (Mail) Box 805, Richmond, Va.

Bligh, Francis L. — Vice-president, foreign operations, Eversman Mfg. Co., 5th and Curtis St., Denver, Colo.

Brown, Thomas A. — Ext. spec., Ontario Dept. of Agriculture. (Mail) Western Ontario Agricultural School, Ridgetown, Ont., Canada

Burer, Maurits T.—Head, mechanization and housing div., Dept. of Agriculture. (Mail) P.O. Box 1170, Paramaribo, Surinam (S. A.)

Clute, Francis H.—Vice-pres., res. and dev., The Clute Corp. (Mail) Box 28, Rocky Ford, Colo.

Colvin, Normal L.—Rural service consultant, Louisiana Power & Light Co. (Mail) 142 Delaronde St., New Orleans 14, La.

Cook, Alan—Res. engr., Butler Mfg. Co. (Mail) 312 W. 46 Terr., Kansas City 12, Mo.

Cottle, Richard A. — District sales mgr., Nice Ball Bearing Co. (Mail) 721 South Blvd., Oak Park, Ill.

Davis, William J.—Soil scientist, Michael Baker, Jr., Inc., Baker Bldg., Rochester, Pa.

Dirmeyer, Richard D., Jr. — Project leader, Colorado State Univ., civil eng. dept., Fort Collins, Colo.

Erichsen, Frank P. — (SCS) USDA. (Mail) P.O. Box 181, Mukwonago, Wis.

Gillogly, Lloyd E. — Eng. spec., (SCS) USDA. (Mail) 2599 Bristol Rd., Columbus 21, Ohio

Green, Robert I. — Provincial soil conservation officer, Agricultural Dept. (Mail) P.O. Box 92, Lilongwe, Nyasaland, B. W. Africa

Gunadasa, Ellawala K. — Tractor mgr., agr. eng. div., Peradeniya, Dept. of Agriculture. (Mail) P.O. Box 1162, California State Polytechnic College, San Luis Obispo, Calif.

Hosford, John—Chief administrative officer, National Association, Domestic and Farm Pump Mfrs. (Mail) 1028 Connecticut Ave., N.W., Washington 6, D. C.

Huber, Samuel G.—Instructor and ext. agr. engr., Ohio State Univ., Columbus, Ohio

Kitchen, William E.—Rural engr., Virginia Electric & Power Co. (Mail) Tappahannock, Va.

Langley, Maurice N. — Chief, operations div., U.S. Bureau of Reclamation. (Mail) 490 16th St., Yuma, Ariz.

Oyster, Harold E. — Sr. farm service rep., Ohio Edison Co., P.O. Box 351, Mansfield, Ohio

Pickett, John T.—Civil engr. and surveyor, P.O. Box 446, Pahokee, Fla.

Perera, Samaraweera A. G. — Eng. asst., Agricultural Machinery Unit, G.O.D.B. Amparai. (Mail) 510 Kotte Rd., Mirihana, Nugegoda, Ceylon

Prokop, Josef, F. — Layout draftsman, International Harvester Co. (Mail) 416 Hilton Ave., Addison, Ill.

Smeltzer, Louis P. — Owner-engr., Winter Crop Experimental Farm. (Mail) 327 Prospect St., La Jolla, Calif.

Sorter, Charles H. — Mgr., Laval Underground Surveys. (Mail) 3960 N. Maroa Ave., Fresno 4, Calif.

Storm, Robert R. — Exec. secretary, National Water Well Association. (Mail) Box 222, Urbana, Ill.

Sweet, Charles L. — Chief, irrigation operations, U.S. Bureau of Reclamation. (Mail) Box 716, Boulder City, Nev.

Walker, James W.—Engr., dev. dept., John Deere Waterloo Tractor Works. (Mail) 1526 Lilac Lane, Cedar Falls, Iowa

Windt, Thomas A. — Asst. ext. agr. engr., B. C. Dept. of Agriculture, Legislative Bldgs., Victoria, B. C., Canada

TRANSFER OF MEMBERSHIP

Adair, Jack W.—Asst. state conservationist, (SCS) USDA. (Mail) 1001 S. Western, Stillwater, Okla. (Associate Member to Member)

Fuhrwerk, Victor C.—Laboratory supervisor, New Idea Div. of Avco Mfg. Corp., Coldwater, Ohio (Associate Member to Member)

Knox, Abba J.—Reg. engr., (SCS) Ministry of Agriculture. (Mail) Mobile Post, Emek Hayarden, Israel — Degania B (Associate Member to Member)

Larson, Lawrence W. — Product designer, International Harvester Co. (Mail) 139 S. Clay St., Hinsdale, Ill. (Associate Member to Member)

McGough, Herbert N.—Chief design engr., W. F. Covington Planter Co., Inc., P.O. Drawer 1249, Dothan, Ala. (Associate Member to Member)

(Continued on page 493)

MANUFACTURERS' LITERATURE

Tractor-Scrapers

Caterpillar Tractor Co.—A 12-page illustrated booklet, Form No. D829, "Moments of Decision," features the Cat DW15 No. 428 tractor-scrapers. The booklet includes on-the-job reports and performance data.

(For more facts circle No. 1 on reply card)

Hammermill Screen Changer

Schutte Pulverizer Co., Inc. — An illustrated bulletin (HW458) introduces a device for changing hammermill screens instantly from the floor above while the mill is still running.

(For more facts circle No. 2 on reply card)

Tube Expanders and Cutters

The Gustav Wiedeke Co. — Catalog No. 81 is a 32-page catalog of photos and descriptions of the company's spinning and burnishing equipment with specifications to assist in making proper selections.

(For more facts circle No. 3 on reply card)

Flexible Tubing

Pennsylvania Flexible Metallic Tubing Co. Inc. — A 32-page catalog describes and illustrates Penflex metal tubing, couplings and joints manufactured by the company.

(For more facts circle No. 4 on reply card)

Packaging and Loading Lumber

Acme Steel Co. — A 28-page "handbook of Instructions for Packaging and Loading Lumber for Shipment in Box Cars" contains illustrations and diagrams to show step-by-step loading procedure and applying steel strapping.

(For more facts circle No. 5 on reply card)

Blowers and Exhausters

Mieble-Dexter Division—A 6-page bulletin giving operating data, specifications and performance curves for 3-lobe rotary industrial blowers and exhausters, featured as having capacities ranging from 50 to 4000 cfm at speeds from 1000 to 4000 rpm with direct or belt drive.

(For more facts circle No. 6 on reply card)

Moisture Indicator

T. W. Prosser Co. — A 12-page booklet describing new irrometer moisture indicator models introducing new construction features which are said to simplify operation. The instrument is equipped with a vacuum gage and a special porous tip which is installed in the crop's root zone. Soil moisture can be read directly from the gage.

(For more facts circle No. 7 on reply card)

Power Pumps

Blackmer Pump Co. — An 8-page catalog, Bulletin 10, describes the company's complete line of rotary power pumps. Photographs and drawings are featured which include external anti-friction, gland and internal anti-friction bearing types, in both sliding and swinging vane styles. It also contains an easy to use pump selection and application guide.

(For more facts circle No. 8 on reply card)

Self-Adjusting Metal Detector

Stearns Magnetic Products, Div. of The Indiana Steel Products Co. — A 4-page bulletin, No. 1101, illustrating the company's Twin Loop electronic metal detector. The unit features an automatic balance control, said to eliminate the need for constant observation and frequent adjustment.

(For more facts circle No. 9 on reply card)

(Continued on page 495)

. . . Applicants
(Continued from page 491)

Murphy, John T.—Owner & mgr., Murphy Tractor Co. (Mail) P.O. Box 1106, Jackson, Tenn. (Associate Member to Member)

Shanks, Clenton W.—Rural engr., Virginia Electric and Power Co., P.O. Box 1194, Richmond, Va. (Associate Member to Member)

Smith, Kenneth C. — Agr. eng. superintendent, Philippine Packing Corp., P.O. Box 1833, Manila, Philippines

STUDENT TRANSFERS

Abramczyk, Joseph A. — Graduate trainee, Ford Tractor Co. (Mail) 9156 Rattle Run Rd., Richmond, Mich.

Allmon, William L.—P. O. Box 165, Newington, Ga.

Beach, Fuller A.—R.R. 4, Walterboro, S. C.

Billington, Kenneth M. — Student, Texas Technological College. (Mail) R.R. 5, Tulia, Tex.

Cochran, Billy J. — R.R. 1, Foxworth, Miss.

Denton, Donald D.—Mercury-Lincoln Dealership, Big Spring, Tex.

Dick, Robert M.—Allis-Chalmers Mfg. Co. (Mail) 9205 N. Smith St., Portland 3, Ore.

Durrence, Gene M.—R.R. 1, Glennville, Ga.

Frank, Robert A., Jr. — (SCS) USDA. (Mail) P.O. Box 754, Mt. Angel, Ore.

Fullilove, William S. — 196 Hampton Ct., Athens, Ga.

Garrett, Roger E.—R.R. 5, Columbia, Mo.

Hamelink, Ronald C.—535 Bailey St., East Lansing, Mich.

Hardy, Leland A.—(SCS) USDA. (Mail) R.R. 2, La Grande, Ore.

Jackson, Kermit J. — On duty with U.S. Navy. (Mail) 2538 Makiki Hts. Rd., Honolulu 14, Hawaii

Johnson, Roy L. — (SCS) USDA, Plainview, Tex.

Jones, Elborn W., Jr. — R.R. 1, Moselle, Miss.

Kaser, Fred D. — On duty with Armed Forces. (Mail) R.R. 3, Box 109, Silverton, Ore.

Kerns, Tom M. — Farmer, Haines, Ore.

Keudell, Kenneth K.—On duty with Armed Forces. (Mail) R.R. 1, Box 160, Aumsville, Ore.

Koelling, James F. — Allis-Chalmers Mfg. Co., Gleaner Works, Independence, Mo.

Laceky, Henry W. — (SCS) USDA, Angleton, Tex.

McKee, Kenneth M. — Mexican Springs, N. M.

McNeary, William W., II — 2026 Beverly Dr., Charlotte, N. C.

Moore, Douglas K. — Collier Carbon and Chemical Co. (Mail) 6526 N.E. 26th Ave., Portland, Ore.

Peach, Arthur M.—R.R. 1, Saltillo, Miss.

Pepper, Donald E. — R.R. 1, Weston, Mo.

Riggs, William N.—R. R. 1, Columbia, Mo.

Rinard, Stanley D. — On duty with U.S. Army. (Mail) 2768 Bell Lane, Eugene, Ore.

Sewell, Paul C., Jr.—R.R. 2, Cave Spring, Ga.

Shackelford, Pat S., Jr.—Box 214, Lexington, Ga.

Skall, Gunther W.—Graduate student, dept. of agr. eng., Rutgers Univ., New Brunswick, N. J.

Skates, William C., Jr.—Avon, Miss.

Smith, Arthur T. — 116 Miller Ave., Auburn, Ala.

Smith, Lawson R. — Broxton, Ga.

Spooner, Joe L. — Br. 1463872, Co. D - 5th Bn., Fort Jackson, S. C.

Vance, John D.—Box 76, Pineola, N. C.

Weeks, Archie D.—R.R. 1, Ellijay, Ga.

Wiggin, Cabot E.—56 Madbury Rd., Durham, N. H.

Woolfolk, Everette L. — R.R. 2, Box 189, Senatobia, Miss.

PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listings.

POSITIONS OPEN — FEBRUARY — O-12-801, 48-803. MARCH — O-37-804, 72-805, 78-806, 83-807. APRIL — O-97-809, 122-811, 121-812, 120-813. MAY — O-129-814, 147-815, 69-817, 132-818, 132-819, 154-820, 159-822. JUNE — O-189-823, 194-824, 199-825, 200-826. JULY — O-256-827.

POSITIONS WANTED — JANUARY — W-447-58, 410-59, 381-60, 466-61, 484-62, 485-63, 3-1, 4-2. FEBRUARY—W-31-5, 33-6. MARCH—W-36-8, 62-9, 46-10, 80-12. APRIL—W-47-13, 77-14, 98-15, 102-16, 107-17, 94-18, 106-19. MAY—W-25-20, 127-21, 128-22, 143-23, 151-24. JUNE—W-175-26, 186-27, 79-28, 192-29, 172-30, 205-31. JULY—W-197-32, 246-33, 223-34, 251-35.

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER for assistant field test engineer assignment with established manufacturer of a large line of farm equipment. Field testing and stress analysis on new models and new items. Midwest location. Degree in agricultural or mechanical engineering. Farm background and practical experience in operating farm equipment. Realistic judgment and ability to work with others. Good opportunity for advancement and for work on a variety of farm equipment. Salary $5,000-6,000. O-266-828

AGRICULTURAL ENGINEER—Agricultural engineering department of a well established university is seeking an alert and personable staff member. Duties to include taking full charge of agricultural power and machinery classes for agricultural degree students, and also to give a course in dairy engineering. The latter course deals with the production and use of steam in a dairy, some elementary electrical principles and applications, and principles of refrigeration. The desired staff member should be mature, responsible, and hold a satisfactory academic record. A man with some experience after graduation would be desirable. O-267-829

AGRICULTURAL ENGINEER who has exceptional ability in sales. Must be willing to travel and relocate in the next 30 days. Ours is a young manufacturing company producing specialized agricultural equipment, such as sprayers, farm driers, complete seed plants, etc. We are constantly looking for and developing new lines. Must be energetic and self-starter type of person. Prefer younger married man who is desirous of earning a good income and has an eye to the future. Salary open. O-276-830

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER for service, writing, or management, in power and machinery or agricultural production with industry in South. Limited travel. Married. Age 34. No disability. BSAE, 1949, Texas A and M College. Farm background. Rural electric line construction one year. Agricultural engineer with Indian Service 3 yr. Factory field representative with major farm equipment manufacturer, one year. Superintendent of maintenance and pastures for 400,000-acre ranch, 4 yr. War service in Merchant Marine with advancement from seaman to first officer. Available on reasonable notice. Salary $6,000 minimum. W-258-38

AGRICULTURAL ENGINEER for extension, teaching, or research in power and machinery, farm structures or rural electric field with public service or trade association. Any location. Interested in opportunity to work on advanced degree. Married. Age 36. No disability. BS degree, 1950, Cornell University. Farm background. One year with manufacturer of bean combines and forage handling equipment. Service manager with farm equipment dealer one year. District extension agricultural engineer 3½ yr. Assistant agricultural agent one year. Undergraduate assistant in agricultural engineering 3 yr. Teaching farm power and machinery, math, physics, hydraulics, and structures in agricultural and technical institute 3 yr. War non-commissioned service in Air Force nearly 3 yr. Available on 30 days notice. Salary open. W-236-39

AGRICULTURAL ENGINEER for extension, teaching, or research in rural electric or product processing field in public service. Any location. Willing to travel. Married. Age 29. No disability. BSAE, 1953, Alabama Polytechnic Institute. Farm background. Undergraduate assistant, in agricultural engineering department. CoOp student 15 months with TVA in electrical development department. Enlisted service in Army Medical Corps 3 yr as medical equipment repairman. Electrification advisor with farm electric coop, 2 yr. Available on 3 weeks notice. Salary $6,000, minimum. W-260-40

AGRICULTURAL ENGINEER for design, development, or research in soil and water field, with public service agency or consultant, anywhere in U.S.A. Married. Age 43. No disability. BSAE, University of Georgia. Experience with USDA, SCS 2 yr as conservation aide, 2 yr as farm planner, 4 yr as work unit conservationist, and 2 yr as agricultural engineer. War enlisted service in Navy 4 yr. Available on 30 days notice. Salary $6500. W-261-41

AGRICULTURAL DEVELOPMENT SPECIALIST for research or extension in soil and water field with industry or public service in northern Midwest or New England area. Married. Age 35. No disability. BSc in agriculture, 1949, University of Glasgow, Scotland. Diploma in dairy science, 1949, Dairy School of Scotland. Assistant agricultural advisor, North of Scotland College of Agriculture, 2 yr. Inspector 5 years, Department of Agriculture, Scotland. Livestock inspector 9 months, Marketing Service, Department of Agriculture, Canada. War Commissioned service in British Army, 4 years. Available now. Salary $8,000. W-242-42

AGRICULTURAL ENGINEER for design, development, or research in power and machinery or product processing with manufacturer or processor, preferably in eastern United States. Single. Age 24. Vision corrected to 20/20 with glasses. BSAE, Pennsylvania State University. Design engineers' training program with farm equipment manufacturer 13 months. Design engineer, US Army biological warfare laboratory, 2 yr. Available October 1. Salary open. W-271-43

AGRONOMIST for farm management, consulting or sales and service work in any branch of agricultural engineering, with manufacturer, distributor, consultant or farming operation in South, Southeast, or Latin America. Limited travel. Married. Age 34. No disability. BSA, 1947, University of Florida. Farm background. Teaching, 2 yr, land appraisal, one year. Farm equipment sales and service, one year. Agronomist with industrial organization, 5 yr. Consulting work, 8 months. Navy commissioned service, 3 yr. Available on 30 days notice. Salary open. W-286-44.

AGRICULTURAL METEOROLOGIST for development and/or operational work in the application of meteorology to agriculture, alone or in combination with other work in soil and water field, with industry or public service, anywhere in USA or possibly other countries. Single. Age 26. No disability. BSA, 1953, California State Polytechnic Institute. Certificate of Competence in Meteorology, 1954, UCLA. MA in Meteorology, 1958, UCLA. Summer work experience as mechanic in farm equipment agency, engineering aide with Bureau of Reclamation, and shop foreman on large mechanized farm. Commissioned service as Meteorologist with US Air Force, 4 yr. Research meteorologist 3 months. Available September 1. Salary $6,000. W-285-45

AGRICULTURAL ENGINEER for development, extension, or management in power and machinery field with farming operation. Any location. Married. Age 47. No disability. Degree as graduate engineer (Agricultural engineering), Technical University at Lwow, Poland, 1943. Related studies in agriculture and engineering at University of Posen, University of Hanover and Warsaw Technical Institute. Experience as agricultural engineer in District of Lublin, Poland, and with Gal Oza Development Board, Ceylon. Available on reasonable notice. Salary open. W-287-46

Report of Test of G. V. C. Quick Drying Bin, National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire, England.

An Electronic Seed Counter, by C. H. Goulden and W. J. Mason. Reprinted from Canadian Journal of Plant Science 38:84-87, January, 1958. Canada Department of Agriculture, Ottawa, Ontario, Canada.

The Mounted Plough, Ploughing Depth and Wheelslip, by Sigfrid Bjerningen. Jordbrukstekniska Institutet, Swedish Institute of Agricultural Engineering, Ultuna, Uppsala 7, Sweden. In English.

Factors to Consider in Feed Mechanization, Farm Electrification Leaflet No. 40, by D. W. Works and E. H. Davis. University of Idaho, College of Agriculture, Moscow, Idaho.

Electrical Terms, Their Meaning and Use. Copies can be obtained by writing to Coordinator's Office, Sou. Ass'n. Ag. Eng. and Vo. Ag., Barrow Hall, Athens, Georgia. Price 75 cents per copy.

. . . Manufacturers' Literature

(Continued from page 492)

Geared Motor Couplings

Link-Belt Co. has released a 4-page folder which describes a new geared coupling for electric motor applications. Folder No. 2875 details pertinent application and selection data for the new couplings. A feature of the coupling centers on the use of spiral cam-locking fasteners which join the cover flanges and are permanently assembled as part of the cover halves, requiring only a quarter turn for fastening or detaching.

(For more facts circle No. 11 on reply card)

Protective Coating Brochure

Industrial Finishes Company, Inc. — An 8-page brochure describing catalytic coating, a rust-inhibitive coating and primer for top coat systems. Coatings are said to be oil, alkali, acid and heat resistant, for surface conditioning to aluminum, brass, copper, iron, isocyanate foam, magnesium, phenolics, plexiglass, polystyrene, steel, tin, wood, zinc, stainless steel, glass, and concrete floors.

(For more facts circle No. 12 on reply card)

New Equipment

Allis-Chalmers Mfg. Co.—A 12-page catalog, TL-1911, which describes the company's All-Crop harvester, and two folders, TL-1906 which covers the No. 7 mower, and TL-1905, a pictorial review of the new A-C forage harvester and forage and grain blower.

(For more facts circle No. 13 on reply card)

Ductile Iron Bulletin

T. B. Wood's Sons Co.—This 12-page, two-color bulletin No. 1102 shows progressively how patterns and molds are made, how the foundry charges and pours the metals, how castings are machined and finished and some of the end products in production of ductile iron.

(For more facts circle No. 14 on reply card)

Manganese Steel Chains

Taylor-Wharton Co., Division of Harsco Corp. — A 16-page illustrated catalog featuring manganese steel chains. A variety of chain types which are reported to become work hardened with use is illustrated. Charts which simplify specification of the proper chain design are included.

(For more facts circle No. 15 on reply card)

Power Transmission

H. S. Watson Co. — Two bulletins containing design information. Bulletin F-10 lists general conditions where shafts and couplings should be considered and Bulletin F-11 contains information prepared to reduce flexible shaft selection and installation to its simplest fundamentals.

(For more facts circle No. 16 on reply card)

Steel and Inflation

United States Steel Corp. — A 292-page illustrated book, entitled Steel and Inflation, published in the interest of dispelling the idea that steel prices have contributed to inflation. The book features the financial story of United States Steel Corp. with facts about costs, prices and profits.

(For more facts circle No. 17 on reply card)

Hydraulic Hose and Fittings

Parker Hannifin Corp.—A 9-page catalog 4430 describes the line of Hoze-Lok fittings and hose. Included are stainless steel braided hose for non-magnetic service and perforated cover hose for coal shooting. Hose assemblies are cataloged and make-up instructions are included.

(For more facts circle No. 18 on reply card)

Index to Advertisers

ADVERTISING REPRESENTATIVES

New York 17 — BILLINGSLEA AND FICKE, 420 Lexington Ave. LExington 2-3667

Chicago 2—DWIGHT EARLY AND SONS, 100 N. La Salle St. CEntral 6-2184

San Francisco 5 — McDONALD-THOMPSON, 625 Market St. YUkon 6-0647

Los Angeles 5 — McDONALD-THOMPSON, 3727 W. Sixth St. DUnkirk 7-5391

Seattle 4 — McDONALD-THOMPSON, 1008 Western Ave. MA. 3-3766

Portland 1—McDONALD-THOMPSON, 912 S. W. Market St. CApital 2-5146

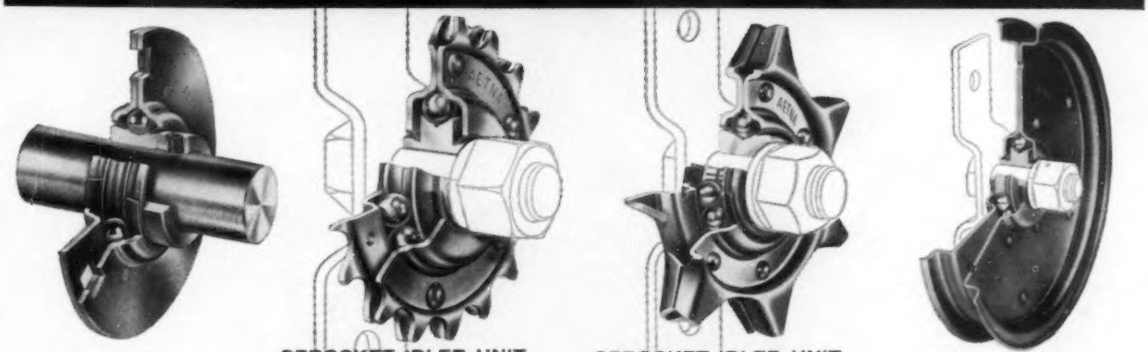
Denver 2—McDONALD-THOMPSON, Colorado National Bank Bldg. KEystone 4-4669

Houston 6—McDONALD-THOMPSON, 3217 Montrose Blvd. JA. 9-6711

Tulsa 4 — McDONALD-THOMPSON, 2010 South Utica. RIverside 3-1981

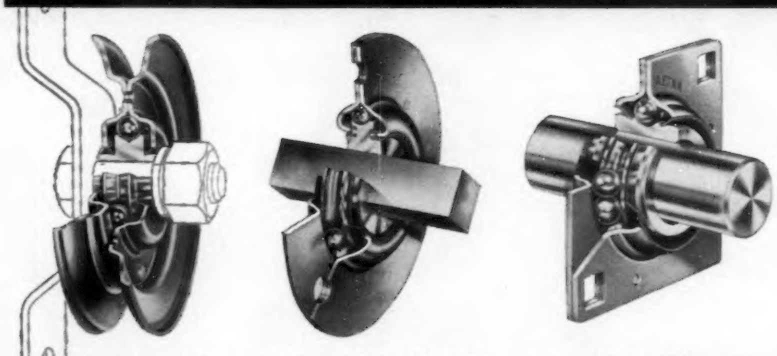
Advertising Manager: RAYMOND OLNEY, 420 Main St., St. Joseph, Mich. YUkon 3-2700

AMERICA'S MOST COMPLETE LINE



ADAPTER UNIT — SPROCKET IDLER UNIT (Single pitch chain type) — SPROCKET IDLER UNIT (Detachable link chain type) — FLAT BELT IDLER UNIT

OF LOW-COST, PRE-LUBRICATED



V-BELT IDLER UNIT — DISC HARROW UNIT — GRAIN ELEVATOR UNIT

The Economy Line That Lets You Put MORE Ball Bearing Efficiency to Work in MORE Places

BALL BEARING *Package* UNITS

Designed and built-to-be-installed-and-forgotten these permanently lubricated, sealed-for-life bearing units require no re-lubrication, no maintenance of any kind. Factory assembled, they combine bearing, seals and housing in a single, compact, easy-to-install *package* that saves time on equipment assembly lines—assure longer, trouble-free performance to equipment users.

Catalog AG-57 gives complete specifications. Write for it on your company letterhead—see how, with minimum or no engineering alterations, these inexpensive bearing units can be adapted to your current or projected equipment designs. Aetna Ball and Roller Bearing Company, Division of Parkersburg-Aetna Corporation, 4600 Schubert Avenue, Chicago 39, Illinois.

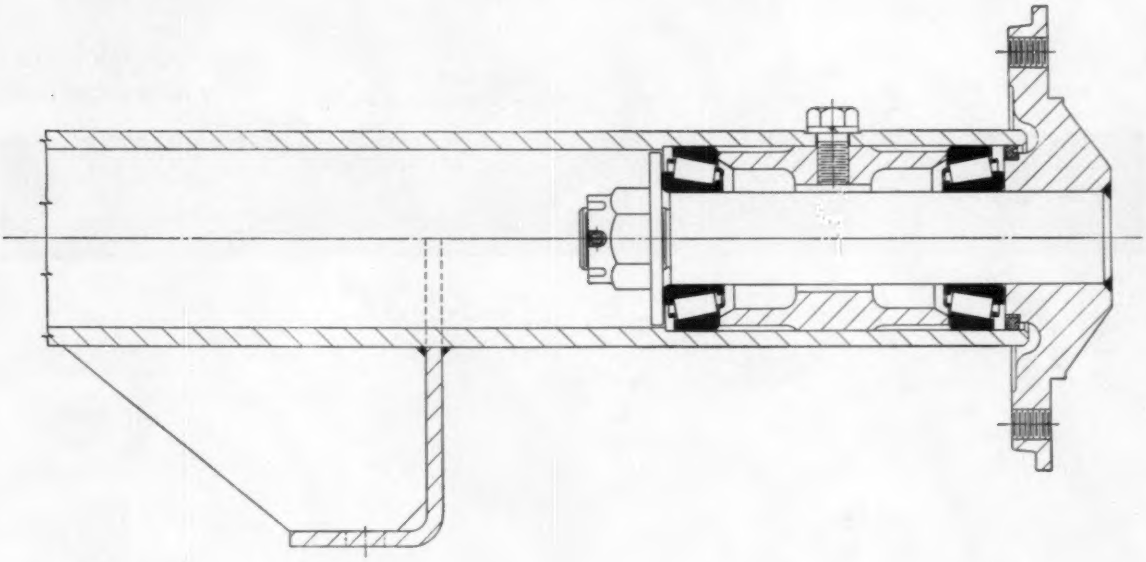
Aetna

Anti-Friction Consultant to Leading Original Equipment Manufacturers Since 1916

(For more facts circle No. 39 on reply card)

Farmhand Co. achieves maximum stability in live axles for its farm wagons

Timken® bearings give maximum rigidity for live axles at front and rear of new wagon



BY using Timken® tapered roller bearings, Farmhand Company achieved maximum stability in live axles for their farm wagon. With Timken bearings they gained all the advantages of live axles for the only farm wagon to use live axles in both front and rear wheels.

By using Timken bearings, Farmhand engineers were able to make a bench assembly of the bearing, complete with seal and bearing adjustment. The full-line contact design and effective spread principle of Timken bearings provide maximum axle rigidity. Through the use of a live axle design, Timken bearing capacity is increased by 25%.

More and more agricultural engineers are standardizing on Timken bearings in farm machines to get greater load-carrying capacity and longer bearing life. The full-line contact between rollers and races gives Timken bearings extra load-carrying capacity. They're case-carburized to have hard, wear-resistant surfaces and tough, shock-resistant cores and the taper in Timken bearings lets them take all the loads from any direction. By keeping housing and shafts concentric, Timken bearings make closures more effective. Dirt stays out; lubricant stays in. And because Timken bearings roll the load—virtually friction-free—they save power and fuel.

With Timken tapered roller bearings, agricultural engineers find answers to three big problems: 1) combination loads; 2) dirt; 3) ease of operation. Timken bearings are designed and manufactured to highest precision standards. We even make our own bearing steel. No other American bearing maker does.

Let our sales engineers help you in designing new bearing applications. Write: The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable: "TIMROSCO".

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

The farmer's assurance of better design

Tapered Roller
TIMKEN BEARING
EQUIPPED

(For more facts circle No. 40 on reply card)